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“A second edition of Dr. Turnbull’s excellent essay on Tinnitus Aurium has been published. Quite a variety of new matter has been added, especially in reference to the value of the galvanic current in such cases.”—*Medical and Surgical Reporter*.

“In this *brochure*, the author, a well-known aural surgeon of the Centennial city, fully discusses a very distressing malady. He assigns nine causes of tinnitus aurium, and the means recommended for its cure. We strongly advise any one interested in the obscure subject of tinnitus aurium to read Dr. Turnbull’s pamphlet.”—*The British Medical Journal*.

ERRATA.

Page 30, third line from top, *for* successive, *read* successful.

Page 79, bottom line and sixteenth line from bottom, *for* Von Trölsch, *read*
Von Tröltzsch.



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IMPERFECT HEARING

AND THE

HYGIENE OF THE EAR.

INCLUDING

NERVOUS SYMPTOMS, TINNITUS AURIUM, AURAL VERTIGO,
DISEASES OF THE NASO-PHARYNGEAL MEMBRANE,
MIDDLE EAR, AND MASTOID REGION.

WITH HOME INSTRUCTION OF THE DEAF.

BY

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American Association for the Advancement of Science, and Mem-
ber of the American Medical Association, etc.

THIRD EDITION, WITH ILLUSTRATIONS.

PHILADELPHIA:
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1881.

J. C. Warren M.D.
4, 21, 82.

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PREFACE TO THIRD EDITION.

THIS little work having been out of print for some years, and a constant desire having been expressed for it, the author has felt it to be a pleasant task to publish a third edition. He has been favored with unusual facilities in bringing his studies on the subject up to the latest knowledge by a visit to Europe, and while there, acting as President to the sub-section of Otology, of the British Medical Association at its meeting at Cork; and later, August, 1879, as a member of the Otological Section at Amsterdam, in which capacity he availed himself of every opportunity of collecting and comparing views with the most distinguished men of Europe as regards diagnosis, prognosis, and success in the treatment of these most obscure affections of the ear. He has also on his return compared those views with those of the able men of this country, while acting as chairman of the Section of Ophthalmology, Otology, and Laryngology, at the meeting of the American Medical Association, which was held in New York City, June, 1880. The necessity of more space for the full discussion of the subjects, has caused the original pamphlet to assume the form of a book, which he trusts will receive the same favor as its predecessor.

LAURENCE TURNBULL.

1502 Walnut Street,

PHILADELPHIA, January, 1881.

PREFACE TO SECOND EDITION.

THE demand for the first edition having been far in excess of the supply, and the reception of the brochure having been of so flattering a nature, both at home and abroad, the author has felt impelled by the importance of his subject, and a sense of duty to his profession, to issue a revised edition of his views in this most distressing of all maladies.

PHILADELPHIA, August, 1875.

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INTRODUCTION.

PROGRESS OF OTOTOLOGY.

PHYSIOLOGICAL ACOUSTICS.

THE progress of the scientific department of otology has been marked by several brilliant discoveries and practical applications within the last few years, chiefly made by Americans. The most important was the talking phonograph of Mr. Edison. When we examined and experimented upon the talking machine of Faber of Vienna, with which he succeeded so admirably in producing articulate sounds, and made an artificial organ of speech to perform the same functions as the corresponding organ in our vocal apparatus, it seemed as if man could go no further in solving the problem of making a machine speak by the application of physiological and acoustic knowledge, but we were more surprised when speaking into a funnel resting on a rotating cylinder, on which there was tinfoil, our articulate words were recorded after us, and by the reversing of that same cylinder they were repeated word for word. In Mr. Edison's machine, the vibrations of articulate speech impress themselves upon a sheet of metallic foil, and are subsequently reproduced from these impressions. Another discovery was that of Henry, Reiss, Gray, and Bell; the one the discoverer of the principle, and the other three the appliers and modifiers of the "telephone" to practical purposes, by combining it with the magnet, and making it available even for the use of the deaf-mute.¹

The earliest experiments for the production of musical sounds at a distance, by means of electro-magnetism, were made by the late Professor Henry and Philip Reiss, of Friedrichsdorf, Germany. His apparatus was capable of producing only one of the characteristics of sound, viz., its pitch. It could not produce different degrees of intensity or other qualities of tones, but merely sung with its own voice, which was not unlike that of a toy trumpet. In the spring of 1874 Mr. Elisha Gray, of Chicago, invented a method of electrical transmission, by means of which the intensity of the tones, as well as their pitch, was properly produced. Subsequently Mr. Gray conceived the idea of controlling the formation of the electric waves, by means of the vibrations of a diaphragm

¹ "A son of a Mr. Saunders, born deaf, has been in charge of Professor Bell for several years, and under his training he has learned to articulate sounds, and talk with facility. The little boy is now capable of speaking to his parents in distinct language, by telephone. This conversation, by means of a flexible wire over a distance of a mile, presents a combination of wonders well calculated to impress the mind with awe, and illustrates the astonishing progress of the age in scientific discovery. Probably no instance of this nature ever occurred before in any country. What are spoken of as miracles in the Bible have now become matters of fact, brought under the notice of every one capable of observing. The 'dumb speak,' not only to those immediately around them, but to those separated by many intervening miles of space."

capable of responding to sounds of every kind traversing the atmosphere, so arranged as to produce these vibrations at a distance. When this was accomplished the problem of transmission and reproduction of articulate speech over an elastic conductor was theoretically solved. In the summer of 1876 Professor A. G. Bell, of the Boston University, exhibited at the Centennial Exhibition in Philadelphia a telephonic apparatus, by which articulate speech could be transmitted over an electric circuit, and reproduced at a distance with some degree of distinctness. The sounds produced were still quite weak, and could only be transmitted at a short distance. Then followed the application of a permanent magnet, instead of a voltaic current, by Professor A. E. Dolbear, of Tufts College, using the same instrument for both sending and receiving, which increased the volume and distinctness of the sounds. Many other modifications of the speaking telephone have been devised, but they all possess certain common characteristics embodied in the original, and are essentially the same in principle, although differing somewhat in matters of detail. All employ a diaphragm at the transmitting station, capable of responding to the acoustic vibrations of the air, also a diaphragm at the receiving end, to be likewise thrown into vibration by the action of the magnetizing helix, which has been improved by Bell and Tainter.

Following upon this were the "microphone" and "audiometer." Not long after the telephone, the microphone, and the phonograph have found their way into common use, a still more extraordinary instrument is announced—one of which the results are as unexpected by the scientific as they are incredible to the ordinary mind. We hear of conversation being carried on by means of a trembling beam of light.

The photophone is the latest development of Professor Graham Bell's ingenuity, and for its scientific novelty, if not for its practical utility, well deserves a brief description. One of the elementary bodies, named selenium, allied to sulphur, is known to undergo certain changes in its molecular structure when light falls upon it. These changes cause the very high resistance it offers to the passage of an electric current to vary slightly, and this curious effect, hitherto believed to be unique, has lately been the subject of investigation by various physicists. It occurred to several that this substance might be employed as a sort of telephone, a beam of light being used to replace the conducting wires of the usual forms of these instruments. Professor Graham Bell, to whom, amongst others, this idea occurred, has had the good fortune to throw that thought into practical shape.

A mirror, from which is reflected a powerful beam of light, may be caused to vibrate by means of the voice. These vibrations toss the beam of light slightly to and fro, and this vibrating beam falls upon a selenium receiver, through which an electric current is passing, thereby creating slight variations in the resistances the current encounters. These tiny variations in electric resistance can be detected and rendered audible by that wonderfully sensitive little instrument the telephone.

The recent experiments of Donders, Politzer, Scott, Blake, and others, with the phonautograph, by means of which tracings of sound waves were written by the vibrating human membrana tympani, with a delicate bristle attached to it, upon the blackened revolving paper of the graphic apparatus, will no doubt tend to some valuable practical results.

Dr. Oscar Wolf has also made researches on the pitch and audibility of the vowels and consonants of the human voice. He further finds that the tracings which

the style of Edison's phonograph imprints upon the tinfoil, show definite figures for each vowel and consonant sound, and he calls them sound figures. A full account of the writer's experiments is given in Chapter I., in which he endeavored to determine, with Dr. Blake and others, the range of perception of the human ear for high musical sounds.

Professor Mayer, of Hoboken, has given the details of an apparatus he has constructed, which will enable us to determine with mathematical exactness the direction from which a sound comes which has reached the ear. Dr. Blake has been experimenting more recently with Bell's telephone in order to determine why some consonants are transmitted by the instrument better than others. To do this he connected a hand telephone with one of Thompson's galvanometers, and then uttered consonants singly into it. The result was that *t*, *p*, *b*, *d*, and *k* caused the greatest, while *m* and *n* caused the least deviation of the magnetic needle, *i. e.*, the former group possessed the greatest and the latter the least logographic value, and one of the results obtained by his experiments is that the consonants which possess the highest logographic value are reproduced least distinctly by the ear piece of the telephone. This explains why *b* is often mistaken for *m*, and *d* for *n* in using the telephone.

Before leaving this part of our subject we must notice briefly another American invention, the audiphone of Mr. Rhodes, in which instrument the bones of the face and temporal region are the medium by which the sound is conducted to the nerve of the ear. The instrument is ingenious, although the principle is old. The invention is yet in its infancy, and may lead to a more perfect apparatus, which may take the place of the present hearing trumpet, and become as useful as spectacles are to the almost blind. A comparative test of both instruments will be found at the end of this work.

PHYSIOLOGY AND PATHOLOGY OF THE EAR.

In the pathology of the ear equal progress has been made within the last few years, as is well observed by an able writer.¹ "Great progress can be claimed, not only in the grosser pathological anatomy of the ear, but also in the histology of the tympanum and its conducting apparatus, and this with our increased appreciation of the physiological functions of the different parts of the ear, and improved methods of examination gives a basis for clinical study and treatment of the diseases of that organ, which compares favorably with those of almost any of the other organs." At the session of "The International Otological Congress," held Oct. 1880, at Milan, S. M. Moos raised the same question concerning the deafness or defects of hearing of railway officials, as has been raised concerning their color-blindness and defects of vision. He affirmed, after statistical examination of a great number of stokers and railway engineers, of which he gave numerical details, that these employés are more subject than others to certain affections of the ear, and to such an extent that the safety of travellers is endangered by it. He concluded his paper by recommendation that all such railroad employés should be examined as to their hearing prior to engagement, and subsequently periodically examined. This resolution was formally adopted by the Congress in the form of an expression of a wish addressed to the various governments to carry into effect. This is an application of the ideas contained in our article in Chapter I.

¹ Dr. Green, of Boston.

TROPHIC NERVES.

The subject of trophic nerves and trophic nerve-centres appears to be as perplexing as ever; and nothing could be more remarkable in its way than the diversity of results obtained by investigators in the region of physiology. We are reminded of this in the many investigations upon "traumatic versus trophic keratitis" by similar investigations upon inflammation of the tympanum. It is now three years since Gellé, of Paris, announced that injury of the nucleus of the trigeminus in the medulla oblongata of the dog, leads to suppuration within the middle ear of the corresponding side, as well as to affections of the eye and nose. This experiment has recently been repeated by Professor Hagan, with the modification that the trunk of the fifth nerve of one side was cut within the skull by a carefully planned incision, made without opening the head (*Archiv f. Exper. Path. und Pharm.*, XI., 1 and 2, page 39). Thirteen animals were operated on, and Professor Hagan's conclusion is that the inflammation which undoubtedly occurs in a small number of cases within the tympanum supports the view that keratitis, after section of the fifth nerve, is traumatic, and not trophic. Still in thirteen cases, the observer found inflammatory signs within the cavity of the middle ear; and we may expect that other physiologists will be disposed to attach more importance to these results than Professor Hagan would appear to have done, and will probably repeat the investigation.¹

EAR-COUGH AND EAR-SNEEZING AS CAUSES OF DEAFNESS.

The subject of ear-cough and ear-sneezing has received a good deal of attention of late, and some interesting cases have been reported² showing the intimate connection which they both have with the middle ear, and how applications to the ear will often relieve a cough of a prolonged and painful character. Again that simply plugging the nostrils will relieve the most distressing sneezing, and prevent its extension into the middle ear producing catarrh; again, if this sneezing is not relieved it may cause so much congestion in the cerebral circulation that small vessels may give way in the labyrinth, causing complete deafness, and that peculiar form of noise termed pulsating tinnitus. The ear-cough occurs from the irritation of the vagus nerve giving off a branch (auricular) to the ear, and others to the larynx as well as branches to the pharynx; it also has occurred in our hands from irritating or touching the chorda-tympani nerve in a case of perforation, as the nerve passes across behind the membrana-tympani. The sneezing is only a more extended impression of that which occurs in the ear-cough, conducted to the vagus by the trigeminus from the ear, and reflected to the phrenic and intercostals to excite the violent expiratory efforts which produce sneezing. Constant gaping is another most disagreeable symptom which was noticed, and causes distress in the ears and deafness of some persons, and is produced by exhaustion or irritation from patency of the Eustachian tubes. Paresis of the palato-tubal muscles, referred to in the body of the work, is likewise a cause of deafness.

Considerations on Paracusis Willisii. — Several explanations had been proposed by the fact of some deaf persons hearing better as long as certain strong noises were produced, especially by the rolling of carriages or cars,

¹ Medical Times and Gazette, Oct. 1879.

² Dr. Lockhart Clark, *British Med. Journal*, Jan. 13, 1870; Dr. James Russell, same *Journal*, Dec. 13, 1879.

mills, etc. Willis proposed to explain this phenomenon by a relaxation of the membrana-tympani, the normal tension of which would be restored by the noise or vibrations of the atmosphere; and other observers admitted a separation in the chain of ossicles. Careful examination of cases of this kind suggested to Dr. Læwenberg different explanations. The very different signs he had noticed in examining with great care the ears of a large number of persons affected with paracsis Willisii, by means of the usual methods of inspecting and testing, gave very divergent results as to the state of the drum; and it was impossible, therefore, to abstract from them a common feature as to the trouble in the middle ear. On the contrary, the symptoms which he had found in all cases were the following. Both ears were affected with deafness, often to different degrees on each side; hearing was good for high tones, especially the higher ones; and, finally, as a negative sign, there was absence of perforation of the membrane. As a rule, he noticed such troubles as headache, giddiness, and in some cases even serious accidents, as apoplexy. The preceding facts seemed to exclude the idea of an affection of the middle ear as the cause of paracsis Willisii. He proposed to seek the explanation of this phenomenon in the following consideration: "We know, especially by recent researches, that excitations, which follow each other, but which are not strong enough to provoke a manifestation of the specific vitality of a nerve, can, under certain circumstances, induce a higher degree of excitability in the nerve, so that it now responds to excitation which would have had no effect under ordinary conditions. In the same manner it seems admissible that there may be certain cases of diminished excitability of the acoustic nerve, and that in these cases the strong commotions produced more or less periodically by the aforesaid noises, may increase the sensibility of the auditory nerve, which is lessened by the disease, and thus enable the patient to perceive vibrations he would not perceive under ordinary circumstances." It appeared to him very probable that such was the case with the persons who offered the striking phenomena of Willis's paracsis.

The Chairman of the Section of Otology, British Medical Association, said that this was a grave symptom. This paper tended to show that it was a secondary symptom, and that it was the beginning of an affection of the auditory nerve. He completely endorsed Dr. Læwenberg's views. According to his experience, this symptom was more common in youth than in later life.

Dr. Cassells (Glasgow) regarded it as a sign of incurable deafness when the person hears better in loud noises, looking at it clinically. It occurs in the course of adhesive catarrhs; and the patient might be assured that his hearing would not become worse when he heard better in a noise.

AUDITORY NERVE.

As this nerve is of much interest and importance we have endeavored to give the most recent views of its physiological position and relations.

The auditory nerve is in direct connection with the cerebellum through the medium of the restiform bodies, as has been demonstrated by the researches of Lockhart Clark and Meynert. Indeed Meynert is of the opinion that all the roots of the auditory nerve terminate in the cerebellum in the first instance, and that, therefore, they can only have an indirect connection with the cerebral hemispheres, probably through the superior peduncles of the cerebellum, or the valve of Vicussens. This view, according to "Ferrier,"¹ is evidently

¹ The Functions of the Brain, pp. 115-159. New York: G. P. Putnam's Sons.

untenable, for he shows there is a special region of the cerebrum, destruction of which abolishes the sense of hearing (the superior temporo-sphenoidal convolutions). "When the lesion was established bilaterally, so as to cause destruction of the superior temporo-sphenoidal convolution of both sides, along with certain other effects not depending on localized injury to this convolution, the animal, though fully conscious, and on the alert to everything attracting sight, failed to respond to auditory stimuli usually exciting violent reaction and attention. The sense of hearing does not appear to be affected in animals deprived of their cerebellum.

Prof. Ferrier repeats the fact which was first demonstrated by Dr. Huhlings Jackson, and which he states is corroborated by clinical medicine and pathology, that nothing is more rare than affections of hearing in connection with cerebellar disease, and occurs only when the lesion is of such a nature as to directly affect the auditory nerves.

Prof. Ferrier further states: "We have seen, however, the essential importance of impressions derived from the labyrinth in the mechanism of equilibration, and this connection of the auditory nerve with the cerebellum is an anatomical confirmation of the view that the cerebellum is the central organ of equilibration."

THERAPEUTICS IN EAR DISEASES.

"The advance in therapeutics has not quite kept pace with our pathological knowledge of the tympanum (and the same may be said of almost every region of the body); the study of the acute diseases which produce tissue changes has become of the greatest importance; the various forms of acute and subacute inflammation, which cause these hypertrophies, adhesions, and destruction of the conducting mechanism of the tympanum, are as difficult to treat, because these changes in the tissues, when once formed, are comparatively incurable, at least according to present existing therapeutic methods. Fortunately, however, in the earlier more acute forms, tympanic diseases are as amenable to treatment as are similar diseases in other organs, and the principles of rational medicine can be as well applied here as elsewhere."¹

In a recent review of the progress of therapeutics of the ear,² it is stated by Lacharriere, who dwells upon the great importance in chronic diseases of the ear, that in every affection of definite duration, search should be made for the diathesis as a cause, *i. e.* scrofula, gout, rheumatism, herpetism, and syphilis. The treatment applied for these latter is of wonderful efficacy, notably the mineral waters. He objects to cold water and sea-baths, as they aggravate labyrinthine and catarrhal affections (in this we fully agree with him, as may be noticed by our short paper, the first on the subject published in this country—1876). The strong sulphurous springs are especially recommended for scrofulous or syphilitic otorrhœas. When there is diseased bone, several cases are reported, in which the waters of Barèges were of wonderful efficacy. If the bone is not affected, the milder sulphur waters may suffice. The arsenical waters of Bourboule, and others, are serviceable in scrofulous affections where the mucous membrane and lymphatic glands are involved. The alkaline springs have been very efficacious in the author's experience for the middle ear affections dependent upon the gouty diathesis. It is well known that sulphur-

¹ Dr. J. O. Green, *op. cit.*

² Dr. A. Hartmann, *Berlin Arch. of Otolology*, June, 1880.

ous waters have a wonderful power upon the system, and when they are applied with discrimination and care are of great value.

Our country is fortunately well supplied with mineral waters which are impregnated with sulphuretted hydrogen, known as sulphur waters, such as those of the Yellowstone region, Arkansas; Richfield, Sharon, and Avon; the White, Red, Warm, and Hot Sulphur Springs of Virginia, which latter are not surpassed by any springs of this character found abroad. Very early we found sulphur and its compounds useful in parasitic diseases of the ear, and in "furunculous otitis" it is almost a specific in the form of sulphide of sodium or calcium. The pain which attends this form of otitis is very great, sometimes extending to the middle ear and membrana tympani, and is relieved by a free incision, instillations into the meatus of a warm solution of atropine, three to four grains to the ounce of water, first recommended by Dr. Williams in his work on the ear. It has been employed in this city for several years with success; it has also been found useful in thickening of the membrana-tympani. A few cases after the incision require a moderate dose of morphia and atropia, hypodermically.

Concerning the treatment of acute *naso-pharyngeal and tympanal catarrh*, we wish to call attention to the fact of the great benefit to be derived from the judicious use of tincture of aconite, also sulphate of quinine, in from eight to ten grains daily, in subdivided doses, in connection with the compound ipecac (Dover's) powder, in from five- to ten-grain doses, at bedtime.

ANTISEPTICS IN EAR DISEASE.

In the search after a perfect antiseptic,¹ Dr. Cassells used boracic acid as a crystal and as a rough powder, but with no result in respect to preventing or arresting suppuration. He then tried the insufflation of various powders into the meatus and down upon the diseased structures. Talc lessened the suppurative action, and seemed to be antiseptic in its action. Tannin alone had no effect on the putrefactive action. When used in alcoholic solution, it formed hard blackish masses in the meatus, and in contact with the diseased structures. Therefore, despite the fact that this solution was very nearly a perfect antiseptic, its use had to be abandoned because of these masses tending to accumulate in the ear with the continued use of the remedy. Iodoform in fine powder failed in most cases to arrest putrefaction; while, in the few cases in which it did, its disagreeable odor was an objection to its employment. He then conceived that the boracic acid had failed on account of the roughness of the powder used. He, therefore, procured boracic acid in an impalpable powder; and, when he began packing the meatus tightly with it, obtained excellent results. But even then he saw that subsequent syringing of the ear with tepid water was followed by a return of the discharge and irritation. In consequence of this, he came to the decision that the ear-syringe was used too often and without due discrimination in the suppurative forms of ear-disease. He had, therefore, given up syringing the ear with pure water in cases in which the antiseptic treatment was to be carried out, preferring to cleanse the tissues with absorbent wool, or, when this did not suffice, by gently syringing the parts with a saturated solution of boracic acid. Therefore, when the above antiseptic treatment was to be employed, the ear was not to be syringed at all, but it should be cleansed

¹ Particulars as to the action of this acid in ear-diseases are given in a paper by Dr. Cassells in the Practitioner for March, 1877.

in the best way possible. Absorbent wool should be used by preference, or a saturated solution of boracic acid. The acid must be packed down into the bottom of the meatus, and the dressing must not be changed unless it be stained by discharge. Not a single case went wrong with him under this treatment. He searched no further, for he had found a perfect antiseptic in boracic acid. All cases of suppurating ear could be treated in the way indicated; and, if properly applied, no danger followed the closure of the meatus by the powder. In many of his chronic cases of profuse suppuration, the first dressing had remained in the ear for weeks, and without being stained. This showed clearly that all putrefactive action had ceased with the application of the boracic acid dressing.

We give the following directions for its use: The ear is first carefully cleansed of secretion with a four per cent. warm solution of the acid, and if there be suppuration of the middle ear the Eustachian tube must be inflated to drive the pus into the external meatus, dried thoroughly, and then finely pulverized boracic acid blown in over the suppurating surface; the meatus is then closed with salicylic, carbolic, or boracic cotton, which should be renewed as often as it becomes moist from the discharge.

Statistics show the favorable action of this treatment upon twenty-nine cases of otitis media purulenta acuta; the average duration of otorrhœa in these was only thirteen days. Of one hundred cases of otitis media purulenta chronica, the average duration of treatment, to the cessation of all discharge, was twenty days.

The pulverized acid has the advantage of producing no reaction on the mucous membrane, of withdrawing the water from the membrane, and keeping a concentrated solution in contact with the inflamed surface, and of not forming coagulations with the secretions.

Dr. Lœwenberg (Paris) said that the absolute alcohol he used as an antiseptic was nearly 95 per cent. He never applied it in this strength at once; he diluted it first; but many patients were soon able to bear the use of the absolute alcohol. As to syringing with salt solutions, he thought that the effect was to avoid a too energetic exosmotic exchange with the tissues, as it might happen with pure water. As to antiseptic treatment, he had prepared a paper for the Milan Otological Meeting on this subject. When the ear had been badly cleaned out, the epidermic fragments extracted from the meatus were surrounded by a concentrated layer of micrococci. M. Pasteur found a special microbium in boils; Dr. Lœwenberg found the same in furuncle of the ear.

Dr. Cassells, in reply, said that he used boracic lint a year before Bezold recommended it.

In cases of otorrhœa complicated by phthisis of the lungs, the acid had no effect upon the discharge. Novaro, of Turin, favored weak chloride of zinc lotions, one to two grains to the ounce of water, for the same purpose.

Urbantschitsch, in his text-book on Otology (Vienna, 1880), dwells on the importance of careful disinfection of all instruments employed in the ear.

Diseases of the Ear and Life Insurance.—Within the last few years more attention has been given to diseases of the ear in relation to life insurance, especially in those affections in which there is a perforation of the membrana tympani with a discharge. There is the closest and most intimate relation between the perforated membrane of the ear and the tympanum and brain, there being only a thin layer of bone called the promontory with a vascular covering exposed to the air, etc. When the ear is much affected, followed by discharge,

pain, dizziness, and fever, it is one of the signs of serious mischief, and may ultimately cause fatal brain-disease in otherwise apparently healthy individuals.¹

Puncturing the Membrana-Tympani.—A full description of this operation is given, which is indicated when the membrana-tympani is bulging from acute catarrhal inflammation, and when mucous râles are heard on inflation, or even in chronic cases when examination of the membrana-tympani shows by a dark line the presence of mucus or serum. Much more important in saving of life is the operation for opening the mastoid cells by means of the proper instruments. Among the many new inventions or modifications of old instruments, it will be proper to refer to the "pneumatic tractor" of Dr. Edward Woakes, of London, as being a valuable modification of "Siegle's" exhausting speculum, a little vacuum instrument, which, when employed with an exhausting syringe, will bring up to its place a recently collapsed membrana-tympani and relieve certain forms of noises in the ear. If the collapsed membrane has remained in its abnormal position a long period, or be held by bands of adhesions, the Siegle's exhausting speculum will be of little avail. The advantage of the "pneumatic tractor" over that of Siegle's is that the entire force which the exhausted receiver is capable of exerting upon the point on which it acts can be brought into operation at once suddenly, so as to even rupture the membrane (three instances of this have occurred), or it may be applied as gradually as may be desired.

Artificial Membranes or Ear-drums.—In the body of this work will be found some new observations from Prof. Gruber's clinic, in Vienna, on the use of these agents. When there is still a portion of the membrana-tympani remaining, an artificial membrane can be employed. When there is pus or mucus in the auditory canal it must be first removed. In the class of cases where there is no membrane to be seen, and nothing remains but the promontory, and perhaps the stapes in position, we have found nothing so useful as the ball or an elongated cone of boracic acid cotton attached to a fine thread and passed down to the proper place where the membrane should be, and the thread placed behind the ear. Two interesting patients now under my care employ this form of apparatus; one is a pupil of our Central High School, and the other is a draughtsman; the former finds ordinary cotton not suitable, and prefers the antiseptic cotton as a long hollow roll on a bodkin; he introduces the cotton on the bodkin, and then withdraws, leaving the cotton in position; and with it he is able to keep his place in his class, and without it he is utterly unable to hear even the loudest voice spoken into his ear, his opposite ear being entirely lost to him from malignant scarlet fever. No form being applicable to all cases, each case must be fitted, like eye-glasses. Another class will bear the use of the thin rubber cloth and metal stem; if pressure is required to bring the little bones in place, it is attached to a fine silver or gold wire. If there are granulations, they must be removed by touching them with sulphate of copper if the bone is affected; if scrofulous, equal parts of tincture of iodine and glycerine, or tincture of iron in the place of the iodine. If the granulations are polypoid in character, they are to be removed by the wire snare or forceps. For the

¹ See Dr. J. P. Cassells' paper on this subject before the International Medical Congress, Amsterdam, 1879, or the valuable work on the same subject by Dr. Edward Buchheim, written under the superintendence of Prof. Gruber, of Vienna: the title is "*Praktischer Leitfaden für Versicherungs-Ärzte*," 1875: also, Urbantschitsch, "Ear Diseases in their connection with Life Insurance Companies," *Allgem. Wien Med. Zeitung*, No. 9, 1880.

treatment of the remains of polypi or granular growths, employ warmed spirits of wine, to be allowed to remain ten or fifteen minutes daily. If hypertrophic or vascular, employ chromic acid, glacial acetic acid, or chloro-acetic acid, or, if these fail, galvanic cautery. If syphilitic, nothing is so useful as iodoform in very fine powder dusted on iodoform cotton. If the granulations are from phthisis, employ tannic acid and carbolic acid combined in equal parts. In plugging the meatus, we find it convenient to moisten the lower portion of the cotton-plug with a small portion of yellow oxide of mercury ointment, one grain to the drachm of vaseline, as the cotton becomes dry, and if not so anointed will adhere to the meatus or auditory canal.

Methods of withdrawing Fluids from the Middle Ear without perforating the Membrana-Tympani.—A variety of methods we have been in the habit of employing to withdraw fluids from the middle ear without perforation. The first and most available is by means of the Eustachian catheter and Politzer's air-bag. Being certain, by means of the otoscope, that the catheter is in the pharyngeal orifice of the tube, it is firmly held, and then the nozzle of the emptied bag is made to fit loosely in the end of the catheter. The air is forced out of the bag, and applied several times to the catheter, the *alæ* of the nose on both sides being first carefully closed over it by the fingers, and the patient desired not to swallow. By this means, in acute and subacute cases of catarrh of the middle ear, we have been able to remove fluid secretions. Another method is employing a glass or metal tube fitted to a syringe, and the tube bent at the same angle as the Eustachian catheter, and then by means of a piece of rubber tubing connected with an exhausting syringe, placing this tube as near as possible to the orifice of the Eustachian tube, by passing the tube through the nose or throat (the tube should have a slight flange or rim, and should always be anointed with ointment, so as to make it fit well). Irritation of the mucous membrane must not be produced, else sneezing is induced and your operation is a failure.

We have more recently employed the rubber end of the pneumatic tractor of Dr. Woakes, applied to the nose to exhaust the middle ear, with an arrangement like Politzer's, instead of being applied to the external meatus, with some benefit in a few cases. A novel and ingenious procedure has been described by Dr. Denison, of Colorado: "Attaching the flat nozzle, used with Politzer's air-bag, to the exhausting bottle of an aspirating apparatus, he first exhausted the air from the bottle, and then compressed the *alæ* of the nose, with the nozzle introduced, so as to wholly exclude air from without, closed his throat as in the act of swallowing, and, at the same time, directed the stopcock of the vacuum-bottle to be turned on. The effect of this transferring of the vacuum to the middle of the head, seemed to draw everything inwards towards the pharynx and nasal passages, creating a temporary congestion of those parts. But the pain in the ear (having a cold at the time) was perceptibly lessened by the experiment, and on its repetition finally wholly disappeared."

Dr. Schalle, of Hamburg, has been endeavoring to find an improved "exudation sucker" after perforation, and has suggested an instrument, which consists of a fine canula, 4 cm. long and 1.4 to 2.5 mm. thick, running into a funnel-shaped, closed tube, 4 mm. in entire circumference, increased by a small, ring-shaped prominence, which bends at nearly right angles from the anterior, or thin, horizontal part of the canula (see figure, Arch. Otolology, 1879, vol. viii., No. 3, p. 215). The thicker part of the canula is united by a short India-rubber tube with a glass tube bent at an angle, to the end of which again a rubber tube, of about 30 cm. long, is united, the canula pieces are of fine silver without sol-

dering. Mode of use : Take the rubber tube into the mouth, pass with the right hand the glass portion of the instrument into the auditory meatus, through a speculum in the ear, and between the edges of the wound, and make suction. He prefers the galvano-cautery for performing the perforation at a white heat.

A morning with Professor Politzer, of Vienna.—Arrangement of office examination of patients.—Acute catarrh of middle ear.—Disease of the ear the result of typhus fever.—Treatment of dry catarrh of middle ear.—Acute mucous catarrh in the aged ; and Ozena.

Nothing is of more interest to a physician or surgeon devoted to a specialty than to have the opportunity of visiting a veteran in his department, seeing his surroundings, and noting his modes of treatment, etc. On the morning of Sept. 25, 1879, we made such a visit, and will now give our impressions. Politzer's rooms for consultation are like most of the European physicians and surgeons, on the upper floors, away from the noise of the streets, etc. Most of them are furnished very nicely with engravings, pictures, cabinets, etc. : besides these, Professor Politzer has his galvanic battery and rheostat, a small air-pump, mercurial air-gauge, lot of small tumblers, and water-bottle. Each patient has his or her distinct glass, and separate soft piece of rubber hose, to fit the air-bag, which they carry away and bring with them. There is a cabinet for Eustachian catheters, each box holding one marked with the patient's name. The first patient was a case of acute catarrh of the middle ear, with effusion of serum of six weeks' duration, very dull of hearing. Politzer, to test the hearing, employed his acoumeter, which consists of a small bar of steel, struck by the hammer, as held between the fingers. He also employs the voice, but did not employ the watch or tuning-fork in this case. He examined the patient with a hand mirror with daylight, no artificial light being employed except in very dull weather. A clip for a lens, as in the ophthalmoscope, was attached to the back of the mirror, and the mirror had a stem, so that he could hold it in his teeth by a small cross bar. The lens was just suitable for my vision without my glasses. He remarked, " You are perhaps a little presbyopic," as he evidently was. He also used exclusively the vulcanite specula, and for the removal of cotton or application of cotton he employed only the curved forceps, no cotton holder as is used in England and America.

We examined the patient, and found an irregular reflex with a yellow membrane. He stated that he had tried his air-douche, with no benefit, and he now proposed paracentesis, as the other means would be very slow. We then held the patient's head, and he made two punctures, but no fluid followed by blowing the nose. Then, by means of Siegle's speculum and a rubber-bulb exhaustor applied to the ear, there exuded a sufficient quantity of serum to run down the cheek, and drop on the floor. He wiped this away, and introduced a pellet of cotton and exhausted, and when he withdrew the cotton it was saturated with serum, which by compression yielded several drops. The advantage of this method was that it prevented the serum from running back. The patient's hearing was then again tested, and it was improved to three times the distance. The patient was directed to wear cotton in his ear, not to smoke, drink wine, beer, or brandy for twenty-four hours, and not be exposed to any kind of physical or mental excitement. The man was a large German.

The next case was a young lad, who stated that some months before he had typhus fever, and after he got well he had an intermittent noise, which had become constant in one ear, with more or less deafness. On examination it was found very much filled up with secretion, which the Doctor washed out. He

had an elegant silver dish (old fashioned), brought in by the man who waited on the door, also a medium-sized syringe and India-rubber ear-basin, such as we employ, using tepid water and boracic acid, about half a teaspoonful in a pint of water. Politzer not only employs boracic acid to remove secretion, but directs the patient at home in all cases to use a four per cent. solution in blenorrhœa or muco-purulent cases. Politzer has found it better than the alkaline solutions.

He stated that all pus was dissolved in the water, but the mucus was to be seen in strings, and was an evidence of the inflammation of the middle ear. On washing the ear out, and then inflating, there was found a perforation, and we inquired if he did not find the noises rare in such cases, and he said, "Yes." The other case which was examined, was also like the first with granulations, but inflation gave no evidence of a perforation. He directed the washing out of the ear twice a day with a solution of boracic acid, also dusting the parts with the powder. For the granulations he touched them with *tinctura ferri sesquichloridi*, taking a drop three times on the point of a bent silver wire, and carrying it right to the part.

Then followed a case of dry catarrh of the middle ear, in which he employed the air-bag for inflation, and drew out the membrane by means of Siegle's application, as we do at the clinic. He found both methods answer a good purpose. He also injects the middle ear, through the catheter, with the following solution: *R.* Sodium bicarbonas, gr. viij, or half a gram; aq. destil. x grams; glycerine, 1 gram. The solution he keeps warm by placing the little syringe in the patient's warm hand. In two cases of little children he uses the word "*varix könig*" instead of "*hick hock*," as suggested by Gruber. In acute mucous catarrh in an old gentleman, he employed the injection into the nose by bending the head to one side, as described by Gruber, and so with children. Then came in an Armenian Jew with a little girl, who had no ear disease but *ozena*. His treatment was nitrate of silver, one part to ten of water, applied on cotton by forceps well into the back part of the nostril and pharynx, wiping round the outside of the nostril, to prevent discoloration, with a solution of caustic potash. He cleansed the parts with the solution of boracic acid before the application of the silver, which he applied once a day, while he gave her a Thudichum's douche to clean the nostrils herself twice a day, also to use the warm douche for three weeks, with the following powder dissolved in water: *R.* Potassæ bicarb., chlorate and salicylate, of each. four parts to one pint of hot water.

A letter from Dr. Cassells, of Glasgow, with his mode of treatment of Eustachian tubal catarrh, acute and chronic.—Use of electricity.—Treatment of the perforations of the membrana-tympani, etc.

"My treatment for tubal catarrh is frequent Politzerization and half ounce doses of the liquor ammon. acet. with one drop of laudanum. for an adult, every two or three hours. In chronic cases I use chloride of ammonium in scruple doses. In acute cases no catheter; in subacute and chronic cases catheterism in addition.

"I never use electricity in these cases, and, indeed, I use it very seldom in any cases. I have applied it with a good, but not permanent result, in cases of supposed paralysis of the tube-muscles, after the mode of Weber-Liel. Too much was expected from the use of electricity in the disease of the ear. It could not create new tissue, but might improve or restore the weakened or lost power of a muscle. There was no clear evidence that the auditory nerve could be stimulated by electricity."

Dr. Woakes sometimes got indications of an improved action of the tensor tympani after applying electricity.

The chairman,¹ said that electricity had been introduced into practice under good auspices, but that its value for diagnosis was very slight. He preferred any other indication, such as might be obtained from clinical observation. He had for some years given it up. The conclusion at which the meeting arrived was, that electricity might be expected to be useful in ear diseases in proportion to the necessity which existed for increasing muscular power in some portion of the conducting apparatus, but that, up to the present, experience pointed to the fact that it was an open question, whether in such cases the results of electric treatment were permanent.

Electricity in Diseases of the Ear.—The almost unanimous expression of the profession, who devote much attention to diseases of the ear, is that electricity cannot be depended upon, except as a means of diagnosis, and to relieve some functional disturbance after all the ordinary means have been employed to place the ear in a healthy condition, as, for instance, in the treatment of "paretic deafness" and in Weber-Liel's "progressive deafness." For the best methods of employing this agent see full account in this work. In paresis of the muscles of the palate one pole should be applied to the vail of the palate posteriorly, while the ordinary sponge-holder is placed on the neck, over superior cervical ganglion, which is reached by making deep pressure behind the angle of the lower jaw, or by introducing a vulcanite catheter (in which there is a wire, which is seen at the tip, passing it there) through the nostrils into the Eustachian orifice, and to this one pole of the battery is connected, and the sponge-holding poles applied over the mastoid process. By passing the metallic stem in our rheophore down in contact with the membrana-tympani with a feeble electric current, the whole middle, and even internal ear, can become influenced through the auricular branch of the auriculo-temporal nerve and otic ganglion. By this means also opacities of this important membrane may thus be influenced, also the relaxed condition of the same membrane, and it will be found, in some cases, useful in relieving tinnitus.

Urbantschitsch,² in his text-book of Otolgy, Vienna, 1880, speaks favorably of the galvanic treatment by stating that he observed in some cases good results from the electric treatment of the acoustic nerve. We find that the galvanic current is uniformly superior to the faradic current in defective hearing as a sequel of cerebro-spinal meningitis.

The experiments of Katyschew³ and Dr. Dobroworsky on the effect of faradization at the neck and the consequent narrowing of the bloodvessels, give the following results: By the faradization of the sympathetic fibres in the neck, the inflammatory redness of the drum-head and the middle ear in myringitis and perforative tympanic disease is rendered less intense, and the subjective sensations (pain and noises) diminish at the same time. The hearing is also improved. By galvanization, also, the inflammatory redness of the drum-head decreases, but the effects are not so constant or so decided; only the closing, opening, and variations in the intensity of the current have their influence.

Dr. Cassell states that "for very recent perforations I do nothing but treat the

¹ W. B. Dalby, F.R.C.S., M.A., of the subsection of Otolgy of the British Medical Association, August 11, 1880.

² See Arch. Otolgy, vol. ix. part 4.

³ See Arch. Otolgy, vol. ix. No. 4.

disease which has occasioned them, in the usual way. These perforations generally come all right in the end, healing up.

"For perforations of longer standing, supposing that their edges have not been cicatrized, I cauterize them gently with nitrate of silver to stimulate them, if they show signs of being sluggish in closing. Otherwise I do not interfere with them, except to treat the disease upon which they depend, antiseptically." A full account of which we have already given.

The great importance of teaching the young deaf, not dumb, child at home, we have advocated in our work, and this has been recently (Sept. 1, 1880) corroborated by Miss Harriet B. Rogers, one of the most successful of the principals of the deaf-mute Institution at Northampton, Mass. Her opinion, after long experience, is as follows: "The early instruction of semi-mutes, who have been taught nothing before coming to school, is often more difficult than that of young congenital mutes." As an aid in teaching articulation visible speech is still highly valued. Articulation can be taught without it, but every aid is welcome. We hoped to derive much benefit from the audiphone, but our experiments with it have been entirely fruitless.

The teachers and friends of the deaf met at Milan, in Italy, in international congress during August and September last. Among more than two hundred delegates to this congress, chiefly from Italy and France, but also from England, Germany, Switzerland, Scandinavia, and the United States, the vote in favor of articulation was more than ten to one, and the following resolutions were adopted:—

"1. This Convention, considering the incontestable superiority of speech over signs—(1) for restoring deaf-mutes to social life; (2) for giving them greater facility of language—declares that the method of articulation should have the preference over that of signs in the instruction and education of the deaf and dumb.

"2. Considering that the simultaneous use of signs and speech has the disadvantage of injuring speech, lip reading, and precision of ideas, the Convention declares that the pure oral method ought to be preferred."

According to F. B. Sandborn, President of the Clark Institution, the American representatives, together with a few others who dissented from these resolutions, admitted the importance of imparting the power of speech and the ability to read from the lips, in all cases where this might be practicable, but maintained that the greatest good of the greatest number is best attained by using signs and the manual alphabet to a limited extent. Had the Clark Institution been represented at Milan, as was our hope, its voice would have been given with the majority, in consequence of its own experience. In the debate, our English friends, Mrs. Ackers and Miss Hull, took part, and the latter spoke warmly of the encouragement she had received from the success of lip-reading she had witnessed at the Clark Institution in 1873.

Dr. Dalby,¹ of London, prefers day schools to asylums, and would begin the education of incurably deaf children at the age of six or seven—eight years being required to teach a child to read from the lips of ordinary persons to be easily understood by them. For the past seven years Dr. Dalby has refrained from recommending either system (by signs or lip-reading) to the parents of the large number of children of all classes who have come under his observa-

¹ On the Educational Treatment of Incurably Deaf Children. By W. B. Dalby, F.R.C.S., M.B., Aural Surgeon, St. George's Hospital. London: J. & A. Churchill, 1880. Pp. 16.

tion, but has given them free opportunity of observing both. In every instance the lip-reading method has been preferred and has been relinquished only for pecuniary reasons. Regarding those who become totally or partially deaf in early life the author remarks that few people know how easily such children become dumb. This occurrence is closely comparable to the loss of a language when a child is taken from one country to another.

To those who desire to study the subject of deaf-mutism we would recommend the recent work of Dr. Hartmann, of Berlin, who treats the subject exhaustively, leaving no department untouched and not omitting any facts worth knowing upon the subject.¹

Deafness the Result of Sympathy between the Ear, Teeth, and Mouth.—It is of the utmost importance that persons suffering with deafness should be provided with artificial teeth, as the loss of the natural teeth causes the soft parts to come too close together, shuts up the orifices of the Eustachian tubes, which are situated on a level with the turbinated bone, and a little higher than the floor of the nose.

The loss of the teeth also prevents that perfect bony conduction which is so necessary for the vibrations of sound to reach the auditory nerve when the other entrance is closed by disease.

I have known, in several instances, when metallic plates were employed for teeth, that an artificial set of teeth would very materially improve the patient's hearing. It is now a well-recognized fact that hard rubber plate will also conduct sound, so that the audiphone and hearing-trumpet have been found useful by some very deaf persons.

Distinct channels of communication exist between the vessels and nerves which regulate the supply of blood to the ear and the otic ganglion, while branches of the fifth nerve connected with the diseased teeth also communicate with this ganglion. Morbid impressions affecting the latter would influence the former, and thereby produce vascular distension of the membrana-tympani and contiguous regions, producing pain, hyperæmia, inflammation, discharge, and even ulceration.²

Boiler Maker's Deafness and Double Hearing.—In a valuable Nomenclature³ of Otology, by Dr. Swan M. Burnett, of Washington, D. C., he classes boiler maker's deafness as an affection of the inner ear; and from reports of some interesting cases, we were disposed to class it as in part due to nervous exhaustion or labyrinthine disease; but from a more careful examination of the ears of boiler makers, we find that they almost always ascribe their trouble to catarrhal disease, from exposure to cold and heat alternately, and in every case that we have examined we have found great thickening and sinking in of the membrana-tympani, with tinnitus of the ordinary steam-like character. No dizziness or pulsating noises, tendency to fall, or pain in the head. The same able authority classes double hearing, "paracosis duplicata," under inner ear diseases. This is still a disputed point, as many authorities treat it under acute catarrhal inflammation of the middle ear: we would be disposed to place it in both positions, as we have found it in both. Prof. Moos is disposed to agree with Dr. Swan M. Burnett, and place this peculiarity among the affections of Corti's organ. Sauvages and Itard observed it in patients suffering with catarrh of the

¹ "Taubstummheit und Taubstummten Bildung, nach den Vorhandenen Quellen, so wie nach eigenen Beobachtungen und Erfahrungen," bearbeitet von Dr. Arthur Hartmann. Ohrenarzt in Berlin. Enke, Stuttgart, 1880. Pp. 212.

² For cases see "Manual of Diseases of the Ear."

³ Supplement to No. 5, National Board of Health Bulletin.

middle ear. In the cases of Von Gumpert, Von Wittich, Swan M. Burnett, and Knapp, there was a more deeply situated inflammation of the ear, evidently affecting the deeper seated tissues of the middle and inner ear; in Von Gumpert's case,¹ "the variation in tone fluctuated between a *third*, a fourth, and an octave," while in Von Wittich's case the tone of a tuning-fork struck the disordered ear at exactly a half tone higher than the sound ear, while in Knapp's case the note of a tuning-fork, placed on the glabella, was heard about two notes higher in the affected ear than in the well ear.²

The Treatment.—If due to catarrh of the middle ear, use Politzer's douche and the liquor ammoniæ acetatis, or catheterization and injection of hydrochlorate of ammonia (gr. x to ʒj of warm water). If from deep-seated disease of the ear, local depletion and counter-irritation; and when the acute disease has been relieved, and exhaustion remains, use phosphoric acid or the phosphate of iron, potassa, and lime, with from six to eight-grain doses of quinine daily. If brain symptoms should show themselves, excitement, vertigo, etc., employ cold to the head, and thirty-grain doses of bromide of potassium every few hours.

CONCLUSIONS.

1st. Much more attention is now given to the subject of diseases of the ear in infants and young children. Especially is this the case in the catarrhal affections of the middle ear following cold or coryza, the exanthemata, and heredito-syphilitic disease of the ear. It has been found that the treatment of the mucous membrane which lines the middle ear is more amenable to such early impressions, and the results are much more satisfactory. This course of treatment was advocated by the late Dr. Clark, of Boston, as early as 1845-46, and we, in a paper on the same subject in 1848-49, dwelt upon the great importance of the early treatment of middle ear troubles in children before such destructive changes had taken place as to prevent all successful results.

2d. The great importance of using the knife in relieving local abscesses in the ear, also of puncturing the membrana-tympani when there is pus, mucous, or blood, has been found entirely satisfactory, and good results have followed.

3d. It will be noticed that we have dwelt upon the great necessity of continued treatment of throat, nose, pharynx, and even larynx, in catarrh of the middle ear; that, while these parts are diseased, a cure cannot be effected of the disease of the ear.

4th. By the aid of the punch of Prof. Gruber any material can be cut so as to fit the ear as an artificial membrana-tympani, and can be introduced, by the use of his little forceps, with ease and comfort to the patient, and each individual case can be fitted to the best advantage.

¹ Klinik für Ohrenheilkunde, pp. 319, 320, 1866.

² Trans. Am. Otol. Society, 1869, p. 31.

CHAPTER I.

THE LIMIT OF PERCEPTION OF MUSICAL TONES BY THE HUMAN EAR.

IN many cases of ear trouble it is desirable to have means of determining the acuteness of hearing, both for ascertaining the present condition of the aural apparatus, and for the establishment of data that shall be sufficiently accurate to define and record the progress of the patient from day to day, and to establish a standard of comparison with other cases. For this purpose the steel rods of Dr. König, of Paris, afford in many respects the most readily available and convenient means, either for clinical or office use. The rods employed by me in these experiments were made of choice white, tempered steel, under the direction of Dr. Clarence J. Blake, of Boston, and have proved perfectly satisfactory. These are held suspended by a silk thread, either close to the ear, or at a definite distance, say thirty-five feet, from the patient, and then tapped on the end with a little steel hammer, which causes a clear, ringing over-tone like a bell. They are two mm. in diameter, and from two and a half to ten centimetres in length, so that they regularly increase from twenty thousand to sixty thousand vibrations in the second, according to their size. This method of examination only determines the limit of the power of perceiving musical tones, or what is technically called the pitch; it is not intended to supersede the tuning-fork, or the ticking of a watch, or even the use of the voice, which tests the power of recognition of the quality and of the intensity of sounds.

In Savart's classical experiments with the toothed wheel, the *lowest* distinctly musical note was declared to be one of eight vibrations in a second; the *highest* was estimated at twenty-four thousand vibrations per second. Helmholtz fixed the lowest limit at sixteen, and the highest at thirty-eight thousand. Vierordt considered the highest to be forty-eight thousand, and Desprets, seventy three thousand seven hundred. Dr. Blake

found the perceptive power of the normal ear to vary considerably with the age, being greatest at the age of twelve or thirteen years, and diminishing in advanced life.

From a number of experiments made some years ago,¹ and those I have made since, I have obtained some interesting results. In the first place my extended experience with various means of testing the acuteness of the hearing has further confirmed me in my preference for König's rods. In using them I observe the precaution to have their temperature at different observations to correspond as nearly as possible, in order to prevent any source of fallacy from their change in shape.² In the second place, the membrana tympani should always be previously examined, and if any morbid condition exists it should be entered in the notes in recording the observation; of course, if the canal be obstructed by cerumen or any foreign growth, no satisfactory determination can be made until it is cleared.

Observing these precautions, I have found that the average of each set of my experiments, while they varied slightly from each other, were generally higher than those of Dr. Blake. In one case sixty thousand vibrations were heard by a gentleman twenty-six years of age, who was a skilled musician, and another gentleman, with a trained ear, distinctly heard the same tone; in quite a number fifty thousand were readily detected; in others, twenty-five thousand represented the extreme limit of perception. Many who were found to fall below the average had

¹ See Proceedings of the American Association for the Advancement of Science, Hartford Meeting, August, 1874.

² The fact should not be overlooked that the conducting power of the air is greatly affected by its temperature. It will be interesting in this connection to compare the results obtained under different temperatures. If air be heated it expands and becomes lighter, and the sound travels more rapidly than through cold air. The late M. Wertheim determined the velocity of sound in air of different temperature as follows:—

Temperature of Air.	Velocity of Sound.
1.5° Centigrade (34.7° F.)	1089 feet.
2.10 " (35.8° F.)	1091 "
8.5 " (47.3° F.)	1109 "
12.0 " (53.6° F.)	1113 "
26.0 " (78.8° F.)	1140 "

At a temperature of one degree and a half above zero, the velocity is 1089 feet a second; at a temperature of 26 degrees it is 1140 feet a second, or a difference of 51 for 24½ degrees, that is to say, an augmentation of velocity of about two feet for every single degree Centigrade. Augmentation of density always produced a diminution of velocity.

never suffered from ear trouble, and believed their hearing to be perfectly normal. It would appear that there are a number of persons who are naturally insensible to sounds above a certain pitch, just as there are some who cannot distinguish between different-colored rays of light of high refractive powers,—that there is a Daltonism of the ear as well as of the eye. The analogy existing between the ability to recognize colors and that of discriminating between different musical tones has been frequently observed, and Dr. Pliny Earle¹ has collected an interesting series of cases, in which the two defects coexisted in the same individual (that is, where a person who was “color blind” also had “no ear for music”). Apart from these exceptional cases, I have concluded from a number of observations that education of the ear has much to do with the acuteness of hearing; this is so true that a person who first tests his hearing with the rods may find that he is unable to distinguish tones higher than a certain pitch, say thirty thousand per second; but in the course of an hour or so, if he practise with them continually, he may hear thirty-five thousand without especial difficulty.

Cases then divide themselves in their acuteness of perception of high tones into three classes: (1) Ordinary patients, or hospital cases from the lower walks of life, all of whose perceptions are more or less dulled, the ear being no exception. (2) Cultivated and refined people, who have no special musical training. (3) Skilled and professional musicians.

Physicians whose ears have been trained in auscultation and percussion, so as to recognize nice distinctions of pitch, would form a class intermediate between (2) and (3). The fact that my observations have been, in this series of experiments, made largely upon professional men will explain why the general results are higher than those of other observers. I have in another place² called attention to the painful character of the impression made by these high tones in some cases. Indeed, an annoying tinnitus may result and continue for several hours, or longer.

In the following series the subjects were all scientific men, either physicians or students. The rods were held within two

¹ Am. Jour. Med. Sciences, vol. xxxv. from “Carpenter’s Physiology,” p. 792. Philadelphia, 1876.

² Proceedings of the American Association for the Advancement of Science, Hartford Meeting, August, 1874.

inches of the ear; their temperature was about 70° F. The observations were conducted in a room remote from noise; weather cloudy and drizzling:—

	Years.	Initial.	Vibrations.	
	22	G. H. R.	50,000	
	23	A. DE W.	50,000	
	24	D. J.	55,000	
	24	J. M.	40,000	
	24	J. M. S.	35,000	
	24	H. F. S.	55,000	M. ²
	25	J. M. B.	50,000	M.
	26	J. E. F.	40,000	
From 20 to 30	26	A. O.	45,000	
	26	H. P.	60,000	
	28	I. O.	40,000	
	29	J. S. T.	40,000	
	29	C. M. T.	45,000	
	30	F. W.	40,000	
	30	J. E. W.	45,000	
	30	C. S. T.	40,000	
	30	W. S. L.	50,000	
	30	G. A. N.	30,000	
From 30 to 50	32	G. McC. ¹	35,000	
	36	J. R.	40,000	
	39	W. K.	50,000	M.
	47	J. A. M.	40,000	
Above 50	48	R. M. S.	40,000	
	52	E. R.	45,000	
	57	L. T.	30,000	

It is of interest to note that in several of the cases where a marked difference was observed between the two ears, this was in favor of the left, with the single exception of the case of the gentleman who distinguished sixty thousand with his right ear and who could get no higher than fifty-five thousand with his left.

The marked difference between the limit at twenty-two and that at fifty-seven years is believed not to be due simply to senile thickening of the membrana tympani, but also to a gradual narrowing and change of shape in the auditory meatus, together with alterations in the middle ear, diminution of conducting power of the bones, and diminished susceptibility of the auditory nerve incident upon advancing years.

¹ Had ear trouble when a child; there was opacity and sinking in of membrane.

² M. stands for musician.

CHAPTER II.

TINNITUS AURIUM, AND OBSERVATIONS ON AURAL OR AUDITORY VERTIGO, WITH DIAGNOSIS AND TREATMENT.

IN various forms of disease of the ear there are associated with the nervous paroxysm vertigo and reeling, with faintness and vomiting. These symptoms may be transient, as from syringing the ears, a sudden pressing of the fingers or speculum into the meatus, violent blowing of the nose, or sudden movement of the body, causing intra-labyrinthine pressure. No doubt other cases depend upon a plug of cerumen, bean, or pea filling up the meatus, or upon some prior disease or irritation of the auditory nerve in its expansion in the labyrinth, or upon some local blood-pressure or reflex disturbances. A still more severe form of aural vertigo is produced by chronic purulent otitis media with the presence of a perforation in the membrana tympani, concussion from firearms, producing a sudden, violent wave of air, which, striking the ears, causes a ringing with deafness and a feeling of vertigo, with a tendency in walking to fall on one side, from congestion and irritation of the fibres of the auditory nerve either by pressure or pulling them.

Another form, in which the patient is giddy when leaning too far backward or forward. Often this class of symptoms depends on contraction of the tensor tympani—a muscle which in action is associated with the masticatory muscles. In almost all these cases there is more or less deafness. There are four other varieties of vertigo which you are no doubt familiar with, and it is not necessary to enter into their symptoms at this time: they are (1), stomacic; (2), nervous, often from sexual exhaustion; (3), ocular; (4), epileptic. These four may be associated with aural or auditory; and great care must be given to be certain

of the diagnosis; but the occurrence of deafness will do much to assist us in arriving at a correct knowledge; and this should always be attended by a careful examination of the ears, and testing the hearing by the watch, tuning-fork, and Politzer's acumeter. Attention must also be paid to the limitation of the field of audition: to the loss of perception of certain notes, as recommended by Knapp.

The following are the conclusions, as to the *modus operandi* of the nervous symptoms of ear disease, by an able authority on diseases of the brain. "There are two sets of symptoms: (a), vital (faintness, perspiration, irregularity of the pulse, etc.); (b), locomotor (vertigo, with or without reeling)." He attributed the former to disturbance of, or actual disease in, the cochlear division; the latter to disease or disturbance of the semicircular canal divisions. The former division was, he suggested, chiefly afferent to the medulla oblongata, the auditory nucleus having close connection with the vagal and spinal accessory nuclei; the latter division, he thought, represented that part going, according to Lockhart Clarke, to the cerebellum. The vital and locomotor symptoms were due to disturbance of the medulla oblongata and cerebellum respectively. Pierret has recently spoken doubtfully as to the existence of relations betwixt the auditory nerve and the cerebellum. Cyon has recently found that irritation of each of the semicircular canals is followed by a particular ocular movement—a very significant thing towards the interpretation of auditory vertigo.

Dr. Edward Woakes, in his work on Giddiness, reports cases in which the auditory apparatus was previously quite healthy, but which may or may not be found affected after the attack. The author traces the connection between stomach-irritation and these attacks of vertigo, and considers them due to a reflex dilatation of the internal auditory artery, causing an increased flow of blood into the semicircular canals. Aural vertigo, the result of secondary inflammation of the labyrinth, is known as *Ménière's disease*, having received much attention from various authorities. Our ideas of its fatal character and the profound deafness as a result have changed because affections of the ears, with many of the group of symptoms before ascribed to this very serious malady, have been treated with success. But there is still another class of cases in which we have the complex symptoms of Ménière's disease associated with profound brain-symp-

toms from injuries of the spine, cerebral tumors, morbid growths of the auditory nerve, either of a fibrous character or true sarcoma or gummata, in which we have added the want of power of controlling the limbs, pain in the head intense and persistent, while the dizziness is increased, with nausea and vomiting, followed by paralysis.

These severe and distressing symptoms are associated with ear disease, especially of a chronic character; and we should be on our guard against being misled by such symptoms in our diagnosis and prognosis. As an instance of how trivial causes can produce Ménière's group, Moos relates the following case: "A peasant was sent to the ear clinic with the diagnosis 'Ménière's disease;' after the removal of a plug of wadding from the right ear, the vertigo, deafness, tinnitus, and vomiting disappeared entirely."

Dr. Henry D. Noyes reports Ménière's group of symptoms following parotitis, and believes that there was a metastatic inflammation set up in the labyrinth of the right ear, at the same time that a similar process took place in the testicle; the patient was totally deaf to all sounds in the right ear; when his eyes were shut in walking, he swerved to the left.¹

In consequence of disease in the conducting apparatus of the ear vertigo may arise, and in such cases the only explanation is, that intra-labyrinthine pressure has called it forth. Gottstein has stated that we have no right to accept the term "*vertigo ab aure laesa*" of the neuropathologist (Charcot), because it remains to be shown whether, for a number of cases, the loss of equilibrium has its origin in the ear or brain. We, therefore, can only speak of Ménière's group of symptoms. This same authority agrees with us that there are two forms, the apoplectic and inflammatory. In a number of cases Gottstein found cerebral manifestations, loss of memory, aphasia, eye trouble, and complete destruction of the hearing power on both sides.²

Many of these forms of aural vertigo are readily detected and removed by the proper remedies; but what we have reference to is the persistent and sometimes painful vertigo, which is not always detected by the most careful physical exploration by one who is fully capable of doing so, and must be referred by exclusion to occur in pathological conditions of the middle ear

¹ Trans. Am. Otological Society, 1879, p. 342.

² Proceedings of German Association, Arch. Otology, p. 13, March, 1880.

or of the labyrinth, especially in apoplectiform deafness, or the otitis labyrinthica of Voltolini. This latter affection is one of the most frequent causes of deaf-muteism. Voltolini defines this affection as acute inflammation of the membranous labyrinth. Usually the disease sets in suddenly; the patient suffers from fever, has a hot and burning skin, and becomes uneasy and excited, with pain in the head; sometimes vomiting ensues, consciousness generally vanishes, either totally or partially, in the first twenty-four hours; at the same time the patient is very much excited and delirious, tossing about in bed; and in children violent screaming occurs. After from two to four days the patient becomes comatose; this condition lasts about two to four days, whereupon consciousness reappears. The child recovers its senses very rapidly, but when it first attempts to walk it is found to stagger. While the tottering gait gradually disappears deafness develops more or less rapidly. This is evidently a disease *sui generis*, and as the opinion of so distinguished and careful an observer as Voltolini has based this on a method of diagnosis we acknowledge, we cannot but receive his judgment until disproven.

I will now pass to the consideration of the details of some interesting cases, including almost all the varieties, one or two being of special interest and importance.

CASE I.—*Labyrinthine vertigo*, the result of inward pressure of the foot of the stapes on the endolymph, and retraction of the membrana tympani, with deafness to the watch when placed on the mastoid process region, but heard on the temporal bone. C. H. D., aged 50; residence, interior of the State of Pennsylvania; neither father nor mother living; the first died of dyspepsia, accompanied by vertigo and general debility, at the age of 79; he was deaf twenty years before his death. The mother died, at the age of 33, of puerperal fever. The patient states he suffers from chronic dyspepsia, with irregular circulation; and ever since he was a student, with periodical attacks of vertigo and vomiting, with torpid liver. He presumes the cause of his tinnitus and deafness to be chronic catarrh from exposure to cold. His former affections were several attacks of continued fever and one of typho-malarial fever, when surgeon in the army, in 1864-65. He has no pain, no discharge, but constant tinnitus for three months. His previous treatment was a prep-

aration of iron and strychnia, with an occasional blue pill, and a somewhat careful diet, avoiding meat.

Examination.—March 22, 1877. Meatus normal, good size, and not dry. Membrana tympani opaque, very concave, and handle of malleus very prominent; the middle ear yields dry auscultation sound. Eustachian tubes open, more narrowed in the right. The distance at which a loud ticking watch is heard on right ear was only $1\frac{1}{2}$ inches; normal, 28 feet. H. D., left, 18 feet; normal, 28 feet. The tuning-fork heard opposite both ears; heard all the notes of a piano except the deepest. The loud ticking watch faint on occiput, not at all over the mastoid, but is heard over the temporal region. Tinnitus and deafness only occurred within the last three months, after a severe attack of vertigo, vomiting with fainting, and a tendency to reel to and fro. When in the railroad cars, cannot distinguish the roaring; when the meatus is closed it diminishes the sound. Cannot keep up conversation in a noise, or where there is any confusion. Has a mechanical difficulty in his nostril; the vomer was injured when a boy, causing slight catarrh. Has slight sore throat occasionally. Has a sister, aged 47, who has been deaf for about twenty years. Symptoms of pressure on the foot of the stirrup, and increased pressure on the endolymph of semicircular canals and cochlea.

Diagnosis.—Labyrinthine vertigo. Disease situated in the horizontal semicircular canals, for, when these are divided, it produces the movement of the head, as in this case, from side to side.

Treatment.—Under the influence of Siegle's exhausting speculum was very comfortable, and freer from the noises. Nitrate of amyl caused no headache and no flushing when the vapor was inhaled through the nostrils or injected into the middle ear by the Eustachian catheter. This patient had also disturbance of vision; and from the confirmed deafness the cochlea is involved, for, according to Flourens, when the cochlea was destroyed in animals they lost the sense of hearing, but not the faculty of equilibrium unless the semicircular canals were injured.

CASE II.—*Vertigo and Loss of Hearing of Certain Tones.* A gentleman from the South, after an attack of giddiness and sickness of the stomach, lost the pitch of certain notes; the

ears were apparently all right. The diagnosis was hemorrhage into the labyrinth or into the vicinity of the cochlea.

The single case of Dr. Cassell's, of Glasgow, Scotland, in which the whole cochlea was removed "by caries" without loss of hearing or impairing the perception of the transmitted tones of the tuning-fork, should not be set aside, or invalidate the report of a case of the removal of this portion of the hearing apparatus with entire and complete loss of hearing. Until we can have both experimental proof and a case like that of Dr. Cassell's, we shall hold on to the reasoning and experimental results obtained by Helmholtz, that the various fibres of the lamina of the cochlea respond to particular musical tones. Upon destroying the cochlea and the structures of the vestibule, Flourens produced deafness. We also know that, when one organ is lost, its power of performing its proper action is taken on by another, or a portion of another will perform its functions; or, as observed by Hinton, that the meatus of one ear facilitates the passage of sound to another; and on testing a case where the cochlea had come away two years before, the man stated he could not satisfy himself that he heard at all on that side.

CASE III.—The following is of special interest in this connection: The derangement of hearing with which this form of vertigo is associated may be of two kinds. Sometimes there is evidence of undue excitation of the auditory nerve, noises in the ears, permanent or only at the moment of the paroxysm. More frequently, indeed almost universally, there is defective sensitiveness. This defect may be conspicuous or obscure; may range from a considerable degree of deafness to a slight defect in audition which it requires much care to ascertain. The knowledge that the defect may be limited to the perception of sound conducted through the bones of the skull is an important addition to our means of diagnosis. The fact was pointed out by the late Mr. Hinton (*Guy's Hospital Reports*, 1873), and by Mr. Dalby; and cases in which it was noted have been published by Dr. Ferrier, Dr. Duffin, and others.

The loss of what may conveniently be termed *perosseal audition* is regarded as evidence of an affection of the labyrinth or of the auditory nerve, and may be absolute. A tuning-fork, vibrating in contact with any part of the head or teeth, may be unheard

in the affected ear, while it is heard readily, if held opposite the meatus; or the loss may be partial, and in that case it may be detected by the method commonly employed by aural surgeons of closing the ears while the tuning-fork is sounding in contact with the vertex or some other part of the skull. Closure of the meatus, if the latter be unobstructed, increases the intensity of the sound; if the perception of sounds conducted through the skull be impaired, it renders it weaker or inaudible. But the method is one that requires much care and repeated examination to detect a slight defect in an unintelligent patient. It is important, however, to examine these cases, not only with a tuning-fork, but with the watch. There may exist marked impairment of perosseal audition to the watch, while the tuning-fork is well heard. This gentleman has been subject for several years to slight attacks of vertigo. The motion is uniform, a tendency to fall to the left. His hearing is acute; it was thought to be perfect. A watch placed opposite the ear is heard perfectly well; but the loudest ticking watch, pressed against any part of the head, is not heard in the least. The condition, however, is a variable one. At times, a watch in contact with the head is heard well; more frequently it is not heard at all. The liability to attacks of vertigo seems to correspond to the periods of imperfect audition. Whenever he has been tested after an attack, the power of hearing the watch has been always absent.

Even a slighter degree of impairment of the power of hearing a watch in contact with the skull may be of significance, as is shown by the following selected case, in which the tuning-fork failed to reveal any abnormality in the function of hearing.

CASE IV.—“P. D., aged 56, admitted into University College Hospital, London, on August 15, 1876, had suffered during the last five years from startings on going to sleep, which lately occurred every night. Four months previously he had a blow on the head and on the bridge of the nose from the fall of plaster. In June (two months before admission) he noticed a considerable degree of deafness of the left ear, which continued for a fortnight, and then passed away. During the six days before admission, a considerable noise in the left ear was noticed. Twice during the preceding months, he had an attack of giddiness of short

duration, of which no definite history could be obtained. The day before his admission, while walking, he suddenly became giddy, as if he were turning round, staggered towards the right side and fell, as he says, in trying to recover himself. A slight sense of movement on his part and in surrounding objects continued until his admission. He then complained much of a 'confusion of sounds,' which seemed to be in his head, and of headache in the occipital region and behind the ears. His hearing at first seemed to be natural. A watch was heard a good and equal distance from each ear. A tuning-fork was heard at eight feet, and was well heard when sounding in contact with the head in various positions, and in each ear it was increased in loudness by closing the meatus. A watch was heard in contact with the head and on the right side; closing the meatus increased its loudness. On the left side, however, closing the ear rendered the sound less loud; but the watch had a double beat, and closure of the ear rendered one set of beats entirely inaudible. This result was obtained in every examination. (The patient was a very intelligent man, and his answers seemed reliable.) A few days after his admission he had another severe attack of giddiness, with great 'confusion of sounds in his left ear.' His rest at night was much disturbed, and he turned about in his sleep until his head came to rest at the foot of the bed. Sometimes he lay curled round, with his head hanging over the edge of the bed. If he were awakened and put straight, on going to sleep again he soon returned to the former position. Five days later he had another attack of vertigo, which continued in a slighter form for some hours, and some peculiar clonic spasm was noticed in his right arm and leg. He appeared able to control it when his attention was directed to it, but when his attention was otherwise engaged, the spasmodic movements went on, the right hand being continually jerked up and down so that the hand kept striking the epigastrium. At the time he said he felt as if he were falling through the bed or swimming about the ward, so that an effort was necessary before he could realize that he was in bed. During the height of the attack he complained of a continuous whirling or humming noise in both ears. A dose of chloral and bromide of potassium quieted him, and on bromide of potassium and iron he had no other severe attack while in the hospital."

CASE V.—*Aural Vertigo with Tinnitus. Old fracture of the spine.* (Much improved under the hydrobromic acid and ether.)

Feb. 12, 1880. J. K. G., aged 61, residing in the country, a widower; father and mother both died at over eighty years of age. The present condition of the health of the patient is feeble; has been a man of remarkable strength. In November, 1863, Mr. G. fractured the last lumbar vertebra, right side. This injury was produced by an exhibition of strength—lifting a barrel of vinegar upon a counter and again placing it on the floor. The fracture was not discovered, and he was allowed to move at intervals. Within two months symptoms of paraplegia manifested themselves; in fact, he was paraplegic for four years. Afterwards hemiplegia set in of the right side of three months' duration. First able to walk with crutches, then two canes, and lastly one cane, which now on going up stairs he pushes before him. He was kept in bed for years under the care of the late Dr. T. Betton and Dr. Gilbert. Within the first week in February was attacked with vertigo in bed, differing from the first vertigo which he suffered from his spine, which was an upward movement of the floor and a downward movement of the ceiling, and when he got out to walk, as if he was walking on a crust of ice. This last attack of vertigo was a whirling motion, with dizziness and an inclination to fall forward, and he was, during each attack, in a profuse perspiration.

Examination of the ears, etc.—Left ear affected; hearing distance three inches with his watch of twenty inches normal distance. The presumed cause of the disease of the ear catarrhal; no pain; tinnitus aurium in left ear is pulsating; right like a sea-shell. The pulsating was synchronous with the heart, which was hypertrophied. Previous treatment: nasal douche with chloride of sodium, half a drachm to the pint; to the throat, which was ulcerated, cupri sulph. twenty grains to the drachm of water, applied with a brush; ulceration of nose, applied twenty-grain solution of argenti nitras, with diluted ointment of nitrate of mercury. This treatment benefited the right ear and suspended the tinnitus which there existed; meatus irritable, but right contained cerumen; membrana tympani opaque and sunken with irregular umbo, with adhesions; right less opaque, not so sunken = H. D. Left, acumeter nine inches; right, acumeter normal; tuning-fork in air heard on forehead, occiput, and top of the head. No member of family deaf.

Diagnosis.—Thickening of the membrana tympani with adhesions, with vertiginous symptoms on pressure of right ear; obstructed Eustachian tube of left side opened by use of Politzer's bag with vapor of hydrobromic ether.

Treatment in consultation with his physician.—Daily inflation with Politzer's bag charged with the vapor of hydrobromic ether; also, R. acid. hydrobromic. (Squibb's) f5j. Sig. Ten drops in a wineglassful of sweetened water three times a day, with a tablespoonful of maltine in milk at bedtime.

Feb. 17. No return of the vertigo since he began the treatment. Hearing distance improved to one foot on left side. The hydrobromic acid caused too much action of the heart, and had to be reduced to five drops.

21st. Still no return of the vertigo; noises much less; a great feeling of weakness in the morning on attempting to get up. Directed to take hot tea before attempting to rise; much relieved; able to resume the acid in ten-drop doses as before.

24th. Patient still improving; hearing better, he states; on testing, find the improvement continues, less of the noises; very cheerful and bright.

May 17. No return of the vertigo; able to walk with more vigor; very slight tinnitus aurium; appetite good; digestion all right, and sleeps well; able to walk out of doors.

The gastric symptoms are especially liable to mislead. In the cases already reported, and the following are admirable illustrations from Dr. Hughlings Jackson.

"A gentleman suffers from frequent attacks of intense dyspepsia and vertigo, the former appearing to him to precede and cause the latter; the vertigo is sudden and violent; he has fallen, and would fall always if he were not careful. He cannot say to what side he falls; but on one occasion must have fallen to the right, as he grazed the right side of his face. He is almost completely deaf on the right side; a watch in contact with the skull on that side is quite inaudible. The hearing on the other side seems unimpaired. The deafness came on gradually about twelve years ago. He has been subject from boyhood to attacks of violent dyspepsia, with vomiting and prostration; in his youth they were as severe as they are now; but he never suffered from vertigo until the onset of his deafness. Since that time the dyspepsia and vertigo have gone on together. The paroxysms of vertigo in his case appear dis-

tinctly to be excited on the attacks of gastric disturbance; they are produced by errors in diet, and the long liability to such dyspepsia indicates that it is not to be regarded as secondary to the aural affection; but the sequence of the symptoms, the coincidence of the liability to vertigo and of the ear disease, indicate clearly that the giddiness is ultimately due to the influence of the latter, although it is excited by the stomach derangement."

VERTIGO.

According to the experience of Prof. J. M. Charcot, *vertigo*, in about three-fourths of the cases, is one of the phenomena which mark the invasion of multioccular sclerosis of the nervous centres. From the descriptions given by his patients, the vertigo was generally of the gyratory kind. All objects seem to be whirling round with great rapidity, and the individual himself feels as if revolving on his axis, threatened with loss of equilibrium. The patient lays hold of whatever is nigh him. In most cases, this giddiness returns in fits of short duration; sometimes, however, it presents itself, almost without interruption for a certain period, superadded to the tremor and paralytic state of the member; it often contributes considerably to render it almost impossible for the patient to stand erect, or continue his titubating walk. You must take care, he states, not to confound this titubation with the uncertainty of gait, in connection with diplopia; the latter ceases when the patient keeps one of his eyes closed.¹ Thus vertigo and diplopia having suddenly shown themselves, paresis and titubation may in a few days, so that the disease, multioccular sclerosis as it were, is immediately established (p. 174). Sometimes the invasion is inaugurated by an apoplectiform attack, preceded for some days or weeks by vertigo and cephalalgia, and followed by temporary hemiplegia. Vertigo is also found in certain forms of epilepsy, and is termed epileptic vertigo, and is never found in hysterio-epilepsy; and the initial cry of the epileptic is wanting. The diminution of persistent vertigo, greater resistance to fatigue, and more sustained continuity of movement are important indications of improvement.

Treatment.—To relieve the persistent neuralgias, frequent

¹ Lectures on the Diseases of the Nervous System, delivered at La Salpêtrière. By J. M. Charcot. Translated by George Segerson, M.D., of Dublin. Phila., Henry C. Lea, 1879, p. 159.

pollutions, etc., nothing has yielded such good results as the bromides; in such cases, hydrobromic acid will take their place, and relieve the reflex excitability, etc.: 15-30 drops, in conjunction with quinine, strychnia, and morphia. The bromides will produce in certain patients redness and paralysis of the pharynx, coryza, urinary hypersecretion, and diarrhœa, but, above all, weakness of the limbs. Hydropathic treatment, warm water, 24° to 28° C., is well borne, and the neuralgias, spasms, and distressing sensation of cold will sometimes disappear. The *acoustic nerve*, according to Topinard, was affected in one hundred and two cases; hearing was affected ten times; and Rosenthal observed disturbance of audition in five cases (enfeebled hearing upon one side). In the majority of cases, the patient complains of annoying noises in the ear, which often prove intractable to treatment. Lucæ and Politzer observed a lesion of the semi-circular canals: the first in a case of gray degeneration of the posterior columns, and the other in a case of tuberculosis.

INTERESTING CASES OF TINNITUS AURIUM FROM ALCOHOL AND TOBACCO SUCCESSFULLY TREATED WITH HYDROBROMIC ACID AND HYDROBROMIC ETHER.

CASE VI. Dr. M. L., aged 35, a physician of extensive practice, became distressed in mind, owing to a persistent tinnitus aurium. He consulted several of his medical friends, had his heart examined, etc.; also one or two who made aural surgery a special study. They could find nothing in his ear, except a slight catarrhal inflammation, which, after a time, passed away under treatment. Still, the noise continued night and day. He had been taking at times a glass of beer, and occasionally a glass of wine; this was changed for red wine when much exhausted. He was advised to try the hydrobromic acid, nitrite of amyl, bromide of potassium, and various other agents; but this all proved of no avail. At last, he was directed to take hydrobromic acid, and to stop beer, wine, etc., absolutely. This course he kept up for a month, and gradually all the noises disappeared.

CASE VII. Dr. J. N. K., aged 45, by occupation a physician and superintendent of a large institution, married, both father and mother living, and his general health vigorous. His left ear affected with slight deafness; the noises are constant, like letting off of steam; has been treated by washing out the meatus by means of glycerine, warm water, etc. Examination:

meatus normal, membrana tympani sunken, reflex impaired, Eustachian tube of left side opens with an effort; middle ear contains no fluid. Hearing distance, left 7 feet, right $7\frac{1}{2}$ feet; acumeter, 13 centimetres on left, 16 centimetres right. Tuning-fork not heard better when both ears are closed about the same in the air, when both meatus are open. Irritability of left nostril, throat, naso-pharyngeal spaces, hyperæmic; never suffered from severe illness; no member of family deaf. Has found himself very irritable in temper, which is a very unusual thing with him. The noises were so loud and persistent that the doctor would call the engineer and inform him that he was sure steam was escaping. He heard also the noises all night, when on a visit to another institution, like the motion of the belt. On making an examination of his heart, found the second sound irregular, and firm pressure on both his carotids stopped the noises temporarily. On an examination of his diet, he took a certain small amount of wine; also, when a certain friend was with him, he would indulge in smoking to excess. The stimulant and narcotic were absolutely forbidden, and the middle ear was inflated, and hydrobromic ether vapor blown into the left Eustachian tube, by means of the catheter. Internally, hydrobromic acid, tincture of aconite to quiet the heart, and maltine. He reported in a month's time that the noises had disappeared entirely.

CASE VIII.—G. W. S., aged 34 years, occupation a student of medicine, mother and father both living, his general health very good. Both ears affected, but the left is most affected. The duration is nine or ten years. The presumed cause, as given by the patient, that it was trouble from his throat. Has no pain, but a constant and distressing pulsating noise in one ear, and a ringing at intervals in the other. Has been under treatment by a distinguished aurist of Boston; employed local agents to the throat, Politzer's air douche, etc. Examination: meatus normal, membrana tympani dull, thickened, and sunken; Eustachian tubes pervious, left much narrowed. H. D. right ear 2 inches, left 1 inch. No obstruction in nostrils, granular pharyngitis, mother and sister deaf. Diagnosis, chronic aural catarrh. Treatment from October 14 to November 14, air douche, iodine vapor, and tincture of iodine, post-aural apparatus. No decided improvement from this course. The following was instituted: the introduction of the Eustachian catheter and air-

bag, so as to exhaust mucus from the tube; he has had a constant feeling of fulness on that side. The middle ear was also inflated and injected with a warm solution of borate of sodium, glycerine, and water. The treatment was followed by rest, and use of maltine as food. Tincture of aconite to quiet the action of his heart, and the use of hydrobromic acid (Squibb's) three times a day. This treatment has entirely relieved the pulsating tinnitus, improved his hearing, and relieved his distress. January 3d was his last visit, and this was his report. The patient, of the impression that the exhausting of the middle ear was the first means of relief which he received, and the use of rest and relaxation from intense study; the hydrobromic acid also acted well, except now and then it would increase too much the action of his heart, then a few drops of tincture of aconite would relieve this sensation.

CASE IX.—J. F. S., aged 45, a distinguished bishop of the Catholic Church, brought me the following note from Hugo Engel, M.D., Lecturer on Electricity, Jefferson Medical College, etc., desiring me to take the case totally under my charge:—

Nov. 27. History.—General condition of health fair; very much exposed, travelling often night and day. The hearing in his left ear has been impaired since childhood, but no pain or discharge for many years; recently the left ear became so troublesome that he had to apply to his physician for relief. His physician had been improving his general health, which owing to exposure to malaria, had affected his whole system, but since the treatment he was better, and thinks his health now good. The chief distress is a constant snapping noise.

The following is the condition of the parts on examination: meatus normal but dry, but with little secretion of cerumen; membrana tympani of left side sunken and adherent; Eustachian tube not open by Valsalva nor Politzer, but by the use of the Eustachian catheter and chloroform vapor, but no influence on the noise. No fluid or hardened mucus or pus in middle ear; Politzer's acumeter heard close to the ear; loud ticking watch fifteen feet normal distance, three inches right; voice elevated in tone when right ear is closed. No obstruction of nose; hoarseness at times in church; uvula elongated and dropsical; this elongation was treated by astringents, etc., but not being relieved the elongated point was removed and a powder

of tannin and iodoform employed by the patient with entire relief to the loss of voice, which was no doubt owing to mucons plugs on the larynx falling down on the vocal cords. On rhinoscopic examination no ulceration of the orifice of the tube, which was only covered with adhesive mucus. No organic heart trouble or disease of any vessel.

Diagnosis.—Slight adherence of the walls of the Eustachian tube; irregular action of the tendon of the tensor tympani muscle, with evidences of anæmic thinning of the blood. Inflated the middle ear with hydrobromic ether and directed twenty drops of the hydrobromic acid (Squibb's) three times a day in sugar and water as a lemonade; employed dialysed iron, from ten to thirty drops; diet, a tumbler of warm milk at night instead of porter or ale, with a tablespoonful of maltine; slight counter-irritation by tincture of iodine at the base of the ear, as there was a slight pain. This treatment was kept up, the patient attending somewhat irregularly, when each time inflation of the tube with the ether, and by Feb. 9 all the distressing symptoms had passed away and he found he was perfectly well. Was directed to continue his medicines in diminished doses, and to keep up the extra nourishment, as his duties were a continual drain upon his nervous system.

CASE X. *Tinnitus aurium for five years, constant ringing of bells.*
—Feb. 6, 1880. Margaret P., aged 10 years, a bright intelligent girl; she is at school, but labors under great difficulty in acquiring her lessons, owing to her deafness. Both ears are affected, but the right is the most affected—duration since childhood. With the exception of cold and intermittent fever there was no known cause. At times she suffers from pain and constant ringing of bells. Has been under the care of a physician, but made no progress. The discharge from right ear is constant and of a yellow color; meatus of right ear very irritable, with polypoid granulations; left is also irritable; membrana tympani of right perforated and thickened; left only thickened and drawn inwards; Eustachian tube of right closed; of left open, but narrowed. Loud-ticking watch heard on contact of right; left, two inches; tuning-fork heard on temple, forehead, and top of the head. Nose swollen and turbinated bone inflamed; has nasal catarrh; tonsils of both sides enlarged and pressing on the orifices of the Eustachian tubes; posterior portion of pharynx

covered with granulations; voice muffled and nasal; very nervous. Father is somewhat deaf; mother is delicate in health.

Diagnosis.—Chronic otitis media, with ulceration and polypi.

Treatment.—Cleansing ear; use of sulphate of copper to ulcerations, powdered boracic acid, inflation of middle ear, etc.; improvement gradual, but damp weather caused always an increase of the deafness, owing to the swelling of the uvula and tonsils; these were removed under the anæsthetic influence of hydrobromic ether. She was placed upon maltine and dialysed iron; also a mixture of hydrobromic acid, glycerine, and water, for the noises. She has been under treatment for a month with great improvement of the hearing and the disappearance of the noises.

USE OF HYDROBROMIC ACID AND HYDROBROMIC ETHER IN TINNITUS AURIUM AND VERTIGO.

For about two years I have been testing the use of hydrobromic acid in cases of diseases of the ear, and also in cases in which I considered it useful in certain nervous diseases of a part or of the whole nervous system. The first preparation which I employed was made by the formula of Fothergill, which has been the most generally employed. It is given in his "Handbook of Treatment," Amer. edit. of 1877, p. 569. This formula, according to Dr. Edward S. Squibb,¹ is loose and inaccurate, yielding a complex solution containing much tartaric acid and potassium, and only containing between eight and nine per cent. of hydrobromic acid, and as the dose is stated to be fʒss to fʒj, by weight, it is only equivalent to four to eight grains of potassium bromide. During 1878 and part of 1879 I used many ounces of this preparation, obtained from one of the very best drug houses in Philadelphia; but I could only say that I derived benefit from the drug in a very few cases—some twenty-eight cases out of one hundred. . . . After I visited Dr. Woakes, of London, who introduced the drug into use in the treatment of certain forms of tinnitus aurium, I told him of my want of success, and he informed me that he had also a like difficulty with certain forms of the acid sold in London, and when he obtained a strong and pure article his success was very gratifying. On my return home I had a consultation with Mr. Charles Bullock, the able chemist, of this city, when we discussed the subject,

¹ Notes on Hydrobromic Acid, pamphlet, p. 11.

and he advised my employing that made by the most accurate process, as described by Dr. Squibb in the pamphlet before referred to, which he kindly sent me. The formula and process for making an acid of the proper strength is as follows:—

Take of Potassium bromide six parts ;

Sulphuric acid, seven parts by weight, sp. gr. 1.833 at 15.6° C.
(60° F.)

Add to the sulphuric acid one part of the water and cool the mixture, then dissolve the potassium bromide in six parts of the water, add the diluted sulphuric acid, and set the mixture aside for twenty-four hours to cool, when a decomposition takes place into hydrobromic acid and the sulphate of potassium. I will not go into all the details; suffice it to state that a troyounce of the acid obtained by this process contains exactly 400 minims (401.48 +), and the fluidounce of 480 minims weigh almost exactly 574 grains (573.8 +); a drachm of it, therefore, would contain 50 minims, and would be the bromine equivalent of 30 grains of potassium bromide. A gramme of the acid is equal to 12.86 minims, and therefore 4 grammes would be 51.44 minims, equal to 30.86 grains of potassium bromide—a very large sedative dose. The doses of the acid I find are much less than that required by the potassium bromide. In most of the cases I commence with ten drops in ten teaspoonfuls of water and one tablespoonful of sugar, which makes a pleasant lemonade and is gratifying to a feverish patient. I increase the dose gradually until I arrive at thirty drops, when, if the headache or vertigo or epileptic convulsions are not relieved, and I find some disturbance of the heart's action, I either diminish the dose or employ in conjunction small doses of tincture of aconite until the heart is relieved. In some cases I combine the potassium bromide with the acid when the urine indicates too much acid in the system, or it produces too much irritation of the urinary passages. In a case of great debility with severe vertigo, I advised the combination of the acid with lithium bromide, which salt contains nearly ninety per cent. of bromine, or more bromine and less base than any neutral salt. It is suggested by Dr. Squibb to saturate the acid with lithium carbonate and adjusting the volume of the solution to the dose required. But experiments bear out the idea that bromine when combined with hydrogen proves more active than when combined with potassium. The

acid as made by Squibb's process, is half the bromine strength of the salt, or thirty-four per cent.

I reported twenty-five successive cases of "tinnitus aurium" at the meeting of the Section of Otology of the British Medical Association at Cork. Since that time I have added the above cases, and one successful case of treatment of tinnitus aurium was reported to me by Dr. C. K. Mills, of this city, under the use of hydrobromic acid, and one in which it at first benefited and then the case relapsed. In a case of tinnitus aurium in which there was the distressing symptom of vertigo, large doses of the hydrobromic acid were employed without benefit; but the post-mortem revealed a tumor involving the auditory nerve. I feel sure that the action of the potash salts has a tendency to break down tissue, and to cause the impairment of function of the muscles of the lower extremities ascribed to the bromide of potassium. The physiological action of free bromine is a corrosive irritant to the stomach, producing pain, vomiting, diarrhoea, and death by exhaustion; on dissection the mucous membrane of the stomach and bowels is found softened; while the action of poisoning by a solution of potassa are acrid and caustic taste in the mouth, burning in the throat, nausea, vomiting of alkaline bloody matters, diarrhoea, convulsions, delirium; while in long continued doses it diminishes the coagulability of the blood, with passive hemorrhages, and general weakness and emaciation.

CASE XI.—*Feb. 22.* B. H., a young lady, aged nineteen, suffering intensely with an attack of scarlet fever with intense cephalalgia, which was not relieved by hot foot baths, active movement of the bowels, cooling lotions, etc., to the head, was directed the hydrobromic acid in ten-drop doses, as before recommended, as a lemonade. After the use of six doses, entire relief to the symptoms, able to open her eyes, and a large, long clot of blood was discharged from the nostrils.

CASE XII.—J. W., aged eighteen, subject to vertigo, tinnitus aurium, and middle ear catarrh, with pain in the head, at times so severe as to disturb her mind and memory. Employed in her case the various means to relieve her middle ear catarrh, and administered thirty-grain doses of potassium bromide, with no improvement in the vertigo or tinnitus aurium for two months; also during another month chloroform, nitrite of amyl, ordinary

ether, and even hydrobromic ether, were all employed, with but slight improvement from the latter agent. When I placed her upon fifteen minims of hydrobromic acid, three times daily, as a lemonade, when the dose had been increased to thirty minims, and she was fully under its influence with the hydrobromic ether, all this noise disappeared. This was one of the cases in which Fothergill's acid was employed, and I am pleased to state that after one year the relief in this case was permanent, as she so reported in person.¹

CONCLUSIONS.

- 1st. Most of the cases of Ménière's symptoms of disease are of a secondary nature, and are due to inflammatory processes within the tympanum, or mastoid cells.
- 2d. In the majority of the cases, the rotation, according to the most recent investigations, is toward the affected side, the attack usually lasting from two to thirty minutes, but in some cases from one to two days.
- 3d. These attacks are often accompanied with tinnitus of a painful and pulsatory character, and are relieved by the use of local measures and hydrobromic acid.
- 4th. The symptoms of tinnitus, giddiness, headache, etc., can all be relieved without entire loss of hearing except in a few rare cases.
- 5th. Local treatment is often successful if, according to Dr. A. Guye,² the cases are not of too long standing.
- 6th. In 1874 M. Charcot, of Paris, recommended the dotted actual cautery over the mastoid process, and sulphate of quinine in doses of ten to fifteen grains daily in inveterate cases of Ménière's disease.

¹ Paper read before the American Medical Association, 1880.

² Paper read before the Otological Section of the International Medical Congress at Amsterdam, Sept. 9, 1879.

Treatment.—In the first class of cases to which we referred—namely, pressure from cerumen upon the membrana tympani—the treatment in the great majority of cases is simply to remove the offending cause by means of the injection of tepid water or weak solution of soda. Numerous cases of this class are relieved by this simple procedure; many of which are of a most distressing character.

The second variety is caused by excessive growth of stiff hairs in the meatus. The treatment consists in carefully cutting the hairs close up to their point of exit by means of curved scissors, and removing each one when cut. The objection to plucking them out is that it will frequently cause an abscess at the termination of the hair-follicle. Another form of this same variety is when a hair becomes detached and falls upon the membrana tympani, from which it must be removed by means of a camel's-hair pencil slightly moistened in glycerine.

A patient in whom pus from an abscess was washed to the surface of the membrana tympani was a distinguished hospital surgeon, who caused it by attempting to wash out his own ear. When the syringe was properly employed in the hands of another, the pus was removed, and the tinnitus ceased.

The third variety of causes is when adhesive mucus is on the posterior surface of the membrana tympani, in the middle ear, or in the mastoid cells. This is removed by the catheter or a few blasts from Politzer's air-bag or douche; if these means are not effectual, paracentesis of the membrana tympani must be performed, and the middle ear washed out with a weak solution of biborate or sulpho-carbolate of soda in warm water. At the same time attention must be given to the naso-pharyngeal region, with the use of the nasal douche, sprays, and gargles.

In the fourth variety, or foreign bodies in the Eustachian tube, the treatment will be to reverse the action of the air-bag and withdraw the air, by means of an elastic catheter in the pharyngeal orifice of the tube, at the same time compressing the nostrils, or by means of a valved bag attached to a curved glass tube introduced through the mouth as near as possible to the orifice of the tube, rarefy the air. If there be much swelling, thickening of the Eustachian tubes, etc., I have found the Eustachian forceps one of the most valuable instruments in making applications of stimulating agents, such as nitrate of silver, sulphate of copper, iodine, and carbolic acid, directly to the parts.

The annexed figures will illustrate the author's Eustachian forceps (Fig. 1), also the improved rheophore (Fig. 2); the first

Fig. 1.

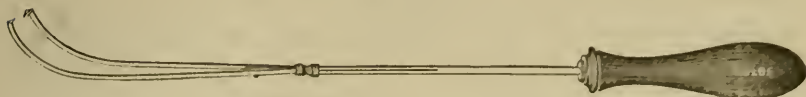
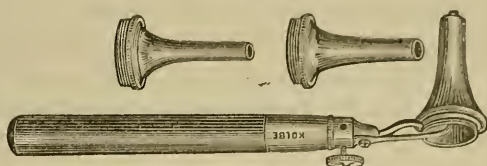


Fig. 2.



to make applications by means of a fine piece of sponge charged with the fluid, either by the nose or under the soft palate, to the Eustachian tubes. The second apparatus is placed in the auditory canal, which being previously half filled with warm salt-and-water, the metallic wire which projects is insulated by the vulcanite envelope. By means of the metallic screw a connection is made with the conductor of a galvanic or inductive apparatus, and the circuit is closed by placing upon the mastoid process the other moist sponge, which communicates with the second conductor, and the galvanic current impresses not only the muscles but the portio-dura nerve by means of a few fascicules of fibres, which constitute what Wrisberg called the "portio-intermedia," forming a connecting link between the auditory and the facial nerve.

Should the foreign body produce inflammation, with effusion, bulging of the membrane, etc., its escape should be facilitated by perforation of the membrane by an aspirator-needle or Professor Gruber's syringe.

In the fifth form, or pulsating tinnitus, the result of some alteration in the bloodvessels, anæmia, or excessive action of the heart, we must try compression of the temporal or carotid, diminishing the frequency of the heart's action by aconite or digitalis; or, if the patient is anæmic, administer the salts of manganese, or the lactate or citrate of iron, with good nourishing diet and out-door exercise, avoiding all forms of excitement, as dancing, violent exercise, or mental effort. Above all use the hydrobromic acid. See reports of cases.

In the sixth class we must make a careful diagnosis by exclusion, to discover whether we have excitement of the brain causing subjective noises, or on the other hand exhaustion of the brain from over-effort or some drain upon the nervous system. For in the first instance we resort to large doses of bromide of potassium, or, if there is any suspicion of syphilitic complication, add the iodide of potassium until we produce bromidism on the one hand or iodidism on the other, with its characteristic eruption.

If it is the second, from exhaustion, we resort to a solution of phosphoric acid employed in the form of a lemonade, or to the phosphites or hypo-phosphites, in conjunction with strychnia or its salts, with the use of the galvanic current to assist in completing the cure.

In the seventh class of cases the operation of tenotomy of the tensor tympani is to be recommended, and the mode of operation is that of Dr. Fr. E. Weber-Liel,¹ of Berlin, which we have here employed in a number of cases with more or less success, depending upon the cause.

In the eighth class of cases, which are generally the result of a patulous condition of the orifice of the Eustachian tube, the remedy should be the application of a powerful solution of nitrate of silver or sulphate of copper or carbolic acid to the mouth of the tube by means of the Eustachian forceps, and washing it by the use of the double Eustachian catheter, with the internal use of strychnia, to stimulate the muscle to contract and close the orifice.

In the ninth class, or "Aspergillus," the vegetable parasite or fungus is to be removed by the injection of spirits of wine with a warm saturated solution of sulphite of soda, and the discharge of mucus or serous fluid is to be checked by the use of an injection of a strong solution of sulphocarbolate of zinc. A number of milder cases of this character we have treated after the summer season in patients who have allowed the sea-water to pass into the ears; a solution of an astringent—acetate of lead or sulphate of zinc—will remove all the symptoms of itching, deafness, and distressing tinnitus, in a very short time.

CASE I.—*Tinnitus.* *The sounds resembling the action of a pump*

¹ Tenotomy of the Tensor Tympani, by Dr. Fr. E. Weber-Liel, Lecturer on Otology, University of Berlin.

and the hissing of a snake, the result of impacted cerumen and the excessive use of tobacco.

Henry L., aged 30, residence Philadelphia, occupation painter, complained of deafness, with sounds like the hissing of a snake and the action of a pump. The patient uses tobacco to excess, both smoking and chewing. He is so deaf in the right ear that a loud ticking watch is only heard in close contact. Left ear almost normal in hearing. On examination of right ear the meatus is found covered with patches of altered cerumen, while the membrana tympani is entirely covered with a concave mass, as if melted by heat. There is not much doubt that by its pressure it first displaced and caused absorption of the air in the middle ear, driving the malleus inwards and pressing the stapes into the fenestra ovalis. Directed a warm solution of biborate of soda, in equal parts of glycerine and water, to be dropped into the meatus warm for three nights, and on the morning of the fourth day the parts were washed out by means of the syringe. This procedure did not give entire relief until fresh warm air was blown in by Politzer's apparatus, when the concave membrane assumed its normal character, and the deafness and sound disappeared.

CASE II.—*Fluttering tinnitus with deafness of one side since June, 1873; the result of bathing. Treatment for two weeks with almost entire relief.*

Oliver W. L., aged 14, student, Berks County, Pa., sent by Dr. E. B. Shapleigh, of Philadelphia. General health good, pulse rapid, no valvular murmur, no enlargement of heart; has constant fluttering noise in left ear; never free, night or day. Mother deaf in both ears, from cold; no other member of the family deaf. Deafness and noises commenced in June, 1873; no discharge, no pain. Left ear—hearing distance $\frac{6}{32}$; right, $\frac{3}{32}$. No disease of auditory canal or membrana tympani. Right Eustachian tube open and free; left contained inspissated mucus. The nasopharyngeal mucous membrane swollen, and considerable discharge from it. Treatment prior to coming under the writer's care, washing out ear, applying counter-irritation, oils, etc., but with no benefit. Treatment first two days, inflated the middle ear; slight relief. Finding the mucus tough and somewhat dry, resorted to Lucae's plan of injecting a few drops of a solution of chloral hydrate (10 to 30 grains) to f̄j of tepid water into the middle ear by means of the Eustachian catheter. This was dis-

agreeable, but not painful; after ten applications, as the results did not afford permanent relief, omitted it, and employed the nasal douche with warm solution of common salt, alternated with solution of zinc sulphas in water, to wash out any accumulation in the naso-pharyngeal space. This relieved him, but only temporarily, and was continued for four days, followed by the use of the galvano-magnetic current, applied by the author's modification of the rheophore of Duchenne. The insulated conductor was passed near to the membrana tympani through a warm solution of chloride of sodium. This gave him considerable pain, but entire relief from the noises, with improved hearing in the left ear, so that he was able to resume his studies.

CASE III.—*Tinnitus the result of chronic catarrh, with depressed membrana tympani (deafness).*

H. G. H., aged 40, native of Pennsylvania; merchant, doing business in Philadelphia; has suffered from constant noises in the left ear, with deafness to low sounds, for years. General health impaired, loss of appetite, and much depression. Applied to the writer December 25, 1873, being recommended by Dr. Levis of this city.

History: frequent attacks of cold in the head; employed tobacco, and had all the symptoms of follicular pharyngitis, with nasal catarrh, using a number of handkerchiefs each day, and expectorating disgusting masses of altered mucus, which was hardened, and in some instances tinged with blood. The left Eustachian tube was narrowed and diminished in its power of opening during deglutition, and the hearing in the left ear to $\frac{1}{3}\frac{2}{3}$; in the right the hearing was $\frac{1}{3}\frac{5}{8}$, and the tube more free. In the right membrana tympani there was subacute inflammation, and handle of malleus injected, with short process very prominent and membrane sunken. Left, no symptoms of inflammation, but deeply-sunken membrane.

Prior to his coming under the writer's care, this gentleman had been under the treatment of almost every quack in this city, and had spent a large sum of money without benefit. He had also been treated by a number of able medical gentlemen, regular members of the profession.

The treatment of the throat, pharynx, etc., was continued until the patient ceased to have the constant discharge. The sunken membrana tympani was elevated by means of Siegle's aural spec-

ulum, and the middle ear was medicated with various solutions, restoring it to a more healthy condition. It was still found that the sounds were moderated, but no definite change in the "tinnitus."

May 8, 1874, performed tenotomy of the tensor tympani after Weber-Liel's method, and placed the patient on the use of a mixture of spiritus terebinthinæ; this was followed by no great change in the sounds. On the 12th, injected through the opening, which had not closed, a warm solution of sulphate of zinc, gr. iij to f3j of water. This was done by fitting the nozzle of the syringe to the meatus by means of an extra india-rubber packing. The syringe was very carefully and gradually employed, until the fluid passed by the nostril. This was followed by a dull heavy pain, and the patient felt faint; relieved by the application of the air-douche, one-fourth grain of morphia by the mouth, and the inhalation of chloroform. He complained also of a crackling like the breaking of bubbles of air; still no permanent relief of the noises, which he likened to those of a boiling tea-kettle.

Faradization was then tried; for several weeks he had the fly-like noise in the ear, but when the application was withdrawn he was no better.

Having tried all the ordinary means of relief, and the throat being improved, middle ear free, membrana tympani raised, I placed the patient upon a supporting and stimulating treatment for his brain, by the use of diluted phosphoric acid, with iron, with decided benefit, while I simply kept the orifice of the Eustachian tube free from mucus by the posterior nasal syringe and solution of common salt. To diminish the fulness of his head and constipation, he was directed a mild saline aperient. This treatment he has been under for some months, and he feels freer from the noises, and is in better spirits, than he has felt for years.

CASE IV.—*Tinnitus the result of collapse of the Eustachian tube, without deafness.*

B. N. B., M. D., aged 34 years, residence Philadelphia, applied April 7, 1874, to the writer, suffering with a buzzing noise in the right ear. This was of four months' duration, and the blowing sound increasing as if into a bottle. It disturbed his sleep, and he was unable to perform his duties with comfort or satisfaction. He had consulted four physicians, and, having some sore throat, all the remedies were applied to it.

On examination, found the hearing of both sides normal, membrana tympani of the right slightly drawn inwards, but no prominence of the handle of the malleus, with no opacity of the membrana tympani. The left Eustachian tube was free, and air passed into the middle ear without any difficulty. The right was found obstructed in the pharyngeal orifice, which the writer endeavored to overcome by the use of the air-douche and Eustachian catheter, which were followed by slight improvement. A few days after, a Eustachian bougie was introduced by the aid of the rhinoscopic mirror, and an application made to the orifice of the tube, of equal parts of diluted carbolic acid and tincture of iodine. This treatment was continued, and removed every trace of the noises. The bougie was a metallic one, acutely curved, introduced by the mouth, and its use was to stimulate the mucous membrane lining the tube, and thus remove the collapse and swelling. This bougie was introduced only into the wide portion of the tube. These bougies are employed from No. 2 to No. 5 of the French scale, and it is well to remember that the distance from the widest portion to the mouth of the isthmus, or narrowest part of the tube, is seventy-four millimetres, and the distance from the point to the tympanitic cavity eleven millimetres, and the width of the cavity thirteen millimetres.

Another case of much the same character came under the writer's notice, but the results were not so satisfactory, owing to the length of time which elapsed before the patient applied for relief. It was as follows:—

CASE V.—Isabella V., aged 25, resident of Philadelphia, a lady of education, and very intelligent, applied May, 1874, stating that she was suffering with a constant buzzing sound without deafness; thought it was due to the result of a very severe cold; no pain. On examination of the offending ear, which was the right, found her hearing was $\frac{1}{3}$ ⁰/₆ left, right $\frac{1}{3}$ ⁴/₆, showing an amount of deafness by the watch which was not noticed in hearing the human voice. In the right meatus there was an excess of cerumen, the removal of which improved that ear to $\frac{2}{3}$ ⁰/₆. The right membrana tympani was found normal. Left membrana tympani sunken, and Eustachian tube of left side closed by a dark mass when it was examined by the rhinoscopic mirror. This was removed by the nasal douche, and the iodine and carbolic

acid applied to the ulcer which was found under it. A strong solution of common salt alternating with a solution of sulphate of zinc was then directed to be employed at home.

May 22. Returned, and expressed her thanks for the relief afforded; she was so much improved as to be able to sleep, and was almost free from the tinnitus unless much excited. She has been under the care of an aural surgeon of this city for three months, who had employed a large Politzer's air-douche at each visit, and the application of the constant current to the ears, which, she stated, instead of improving her had only increased her distress.

We have now and then very favorable results from the galvanic excitement in isolated cases, as may be noticed by a reference to the author's statement of cases of nervous deafness treated by Brenner's formula;¹ yet Brenner states that he had failed in seventeen cases of tinnitus. In a carefully prepared paper by H. Schwartze,² of Halle, he observes, "I am far from denying favorable effects of the galvanic excitement in isolated cases, but I have not been able to convince myself at any time of any real and permanent results from galvanization. . . . Moreover, we must remember that a series of (more recent) ear-troubles, also of such whose causes must be sought for in the cranial cavity, are capable of a spontaneous cure. Whoever has not frequently convinced himself of this fact is apt to over-estimate his therapeutics. The physician who is in the habit of treating all diseases by the preference of *one* remedy, as for example, electro-therapeutics, of necessity over-estimates the results of his favorite remedy." See *two cases* of tinnitus aurium reported as treated with success by Dr. Thos. F. Rumbold, by the galvanic current, with zinc and carbon battery of eighteen, ten, seven, and four cups, after local medication by solution of muriate of ammonia, and also by a solution of carbolic acid and ext. pinus Canadensis into the pharyngo-nasal cavity by spray-producer, with inflation continued for two and a half months. The doctor avoided the opening reaction of the anode. His conclusions are as follows: "In nearly one-fourth of my cases electricity has been either a valuable adjuvant or a specific."³

¹ Turnbull, Clinical Manual of the Diseases of the Ear, p. 389.

² Archiv für Ohrenheilkunde, March, 1874.

³ Arch. Electricity and Neurology, vol. i. May, 1874, p. 54.

Dr. Seely of Cincinnati, in an article on the use of galvanism in ophthalmic and aural affections, states his opinion in reference to the latter: "My attempts thus far have been rewarded by more hopes than practical results."¹

Prof. Benedict² is reported to have stated in reference to tinnitus aurium: "This disorder is best cured by the galvanization of the great sympathetic in the neck and the so-called external application of the galvanic current,—*i. e.*, one electrode applied to the ear, and the other, as a wet compress, placed around the forehead of the corresponding side. Frequent inversions of the direction of the current are useful." *One* successful case is reported.

George P. Field, M.R.C.S., Aural Surgeon to St. Mary's Hospital, and Lecturer on Aural Surgery in the Medical School, London, has published a work on "Tinnitus Aurium" (8vo., cloth, 2d edition). In this work he states that—

"The remedies used in times past are touched upon, and finally the treatment which he suggests—namely, faradization of the membrana tympani and of the intrinsic muscles of the ear—is illustrated by recording some fifteen cases under treatment, together with the results obtained.

"He uses Dr. Stöhrer's double-celled induction apparatus, and passes the current directly on to the membrana tympani by means of a vulcanite speculum with a piece of platinum wire passed through it and attached to one of the wires of the battery. As the speculum is not actually in contact with the membrana tympani, a silver probe is made to touch the platinum, and at the same time the membrana tympani. A very weak current is applied at first, and gradually strengthened. If the current is too strong, hemorrhage or acute pain may be the result.

"The fifteen cases reported are from among cases treated by Mr. Field at the hospital.

"Without going into a description of the cases, it may be sufficient to say that in all various noises and singing in the ears gradually disappeared under the repeated application of the current, and that in all the deafness decreased, as shown by the distance at which the watch could be heard."

¹ Arch. Electricity and Neurology, vol. i. November, 1874, p. 221.

² Id., vol. ii. May, 1875.

CASE VI.—*Extreme deafness, with noises, from sunstroke.*

HENRY C. K., aged 44, had suffered from complete deafness of eight years' duration; supposed cause, sunstroke. He had applied cold water to his head after exposure to the intense heat of the sun; no pain; says he has ordinary noises in the ear. His deafness commenced in California. Has also granular pharyngitis, extending into Eustachian tubes, with ulceration of the mucous membrane lining the vomer. Left Eustachian tube closed. The right Eustachian tube is pervious, but much narrowed. Cicatrix on left membrana tympani. Right membrana tympani more normal in appearance. Watch not heard on either side. Tuning-fork heard only on temporal bones. The patient having tried all manner of treatment without success, the writer perforated the membrana tympani, and, with Weber's improved tenotome, divided the tendon of the tensor tympani, with the assistance of the resident physician of Howard Hospital, Dr. Parrish. The operation was followed by pain and a few drops of blood.

Directed oil of turpentine, ten drops every three hours, in mucilage of gum arabic, until all the acute symptoms had disappeared; electricity was then applied by Dr. Warrington, who has furnished the following notes of the case:—

July 21. First application of electricity. Stöhrer's battery, six cells. Cathode in ear; anode in right hand. No impression.

22d. Eight cells. Slight sensation of sound.

August 1. Eight cells. Continued to apply electricity six times a week, about the same force and the same effect; hearing constantly improving. The throat treated by scarification and application of tincture of iodine and glycerin, equal parts; improvement. Internal treatment, iodide of potassium from four to eight grains three times a day, combined with tincture of columbo or ginger; also chlorate of potash, ʒij; tincture of chloride of iron, fʒij; syrup, fʒj; glycerin, fʒj; water, fʒiij.—M. Tablespoonful doses three times a day. The patient felt so much better that he desired the operation of tenotomy of tensor tympani of the other ear.

September 20. On performing the operation, he was immediately deprived of the power to hear words in that ear. Inflammation and suppuration followed. Eustachian tube became very patulous. On speaking into the ear, words were seldom distinguished, but the sound was intense and distressing. Throat more

inflamed. Injected the ear with sulphate of zinc, gr. iij; sulphate of morphia, gr. j; water, 3j. Symptoms of improvement, and some return of hearing. In three weeks applied electricity, eight cells, slight effect.

October 10. Throat improved; hearing in right ear good, also in left ear.

December 11. Hearing for sounds better than at any time since the operation. Throat well; able to hear words in conversation better than ever before.

CASE VII.—*Concussion with extravasation of blood into labyrinth, terminating in an acute attack with deposit in the mastoid cells, with deafness and severe tinnitus of left ear.*

Edward McH., native of Wales, aged 45. He stated that, when passing up the Mississippi River during the war, on the flag-ship "Hartford," under Commodore Farragut, a cannon was fired immediately over his head, the left ear being towards the gun. So close was he that his hair was burned. He immediately became insensible, and, on arousing in about an hour, found himself very giddy, and with pain in his head, but not in the ears. Nausea and vomiting were present, and occasionally occurred during the following two or three days. Prior to this accident he could always hear well, and never had any trouble with either ear. Since the accident the left ear has been almost completely deaf, but at no time has he had tinnitus in that ear. At the same time, hearing diminished in the right ear, but was not abolished.

About September 15, 1873, right ear lost almost entire appreciation of sound, when tinnitus and buzzing supervened.

About October 1st a purulent discharge appeared in right ear.

Oct. 27. At present both membranes perforated; left apparently drawn in; purulent discharge from right meatus. Had both washed out, and applied argenti nitras in solution.

30th. Hearing improved in right ear; left ear still very deaf; perforation of right apparently healing; that of left still very large. Solution of argenti nitras passed into left ear; it is felt in the pharynx, and is tasted by the patient.

Nov. 2. Hearing much improved in right ear, but severe pain in it and mastoid cells and over right side of head, with swelling. I punctured the swelling down to the bone with a bistoury, giving severe pain at the time, and causing the man to become quite pale and faint.

6th. Returns entirely free from pain. Hearing much improved, and tinnitus entirely gone. Patient much pleased with result.

CASE VIII.—*Concussion with symptoms of aural vertigo (extravasation of blood into labyrinth or semicircular canals?).*

During the summer of 1864 a patient, a soldier, in apparent general good health, very deaf, and with constant and great tremulousness of head and upper extremities chiefly, but also to some extent of lower extremities; very giddy on attempting to walk, and gait very unsteady. He stated that a few days previously, while lying in front of the breastworks, a heavy cannon was fired in close proximity to him, and that the ball passed but a few feet from his head. He was instantly rendered unconscious, and continued so for a few hours. On returning to consciousness, found himself in condition as above. He was on his way home on furlough when examined, and he was not again heard from.

CASE IX.—*Deafness, but hearing by the use of the ear-trumpet; tinnitus with distressing vertigo; patient relieved by the operation of tenotomy of the tensor tympani.*

The following are the notes of this case: George B., aged 45, Princeton, Indiana, applied May 16, 1874. Has been a merchant in the neighborhood of Pike's Peak; was a soldier for one year, but was discharged on account of his deafness and his liability to fall from dizziness. History: has had no children's diseases, but had intermittent fever for ten years, with enlargement of the spleen. Has never had any pain in his ears, but on one occasion accidentally struck his left ear with much force, and had a discharge of yellowish pus for one week. In the year 1859 heard as well as any one; became interested in a mill, when, owing to exposure, "his hearing began to leave him." He became a soldier, but he could not bear the fife or drum; and yet he could distinguish some of the low notes of the piano but none of the upper notes; could hear the human voice in his own ear-trumpet, made by himself, of thin platinum in the form of an auricle, which was so light in weight that he balanced it in one ear. The treatment he had been under consisted in syringing the ear, and soon after it was followed by a pulsating noise in the left ear, which was at first intermittent, but after a time became constant. He had in his right ear sounds like a letting-off of steam. He had been

under physicians at his home and in New York City. Examination: external meatus normal; chronic inflammation of membrana tympani of left ear, with injection along the handle of the malleus, with deposit of lymph and adhesions. This was evidently the effect of the blow. Right membrana tympani injected, with depression, with deposit of lymph on the vessels along the handle of the malleus. Rhinoscopic examination of the orifices of the Eustachian tubes: left, open and patulous, with enlarged glands; right not so much open. Tuning-fork heard best in the right ear; left not so perfect, showing conduction of the bones of the head, and not entire paralysis of the auditory nerve, as in the other case. Examination by exhausting the air by Siegle's pneumatic apparatus repeatedly applied, afforded no relief to the pulsating noises. Pressure by shutting the nose modified them somewhat. Faradization with the sponge on insulated wire produced a sound like that of a fly on a window-pane; on increasing the power the pain became much more intense under the ear and in his teeth, but no relief to the tinnitus. By the use of the author's double otoscope, heard the sound of the air loudest in the right Eustachian tube.

May 26th. Decided to operate by tenotomy of the tensor tympani, and to break up the adhesions as the only chance for relief. This was performed at Howard Hospital, assisted by the resident physician, Dr. J. Barr (1874), and in the presence of two medical students. On perforating the drum, there was some difficulty in dividing the tendon of the muscle, which was unusually thick and resistant, and the patient experienced considerable pain, owing to the adhesions which had to be broken up by passing the knife under them. To prevent inflammation, the ear was carefully covered up, and a mixture of terebinthinæ spiritus and ammonii chloridi given three times a day.

Reported same day; parts looking very well and open; all pain ceased by 7 P. M. the evening of the operation. Feels relieved of a certain disagreeable sensation in his head (vertigo)—feeling of falling.

30th. Still continues well; injected a solution of one grain of sulphate of zinc through the opening; not much pain; this was repeated twice.

The patient left for his home in a few days after the operation, and when he arrived the writer received the following letter from him, in which he states, "I arrived at home all right; no trouble

with ear. The left Eustachian tube is now more open than it ever was; hearing about the same in both ears; had no trouble with my head since the operation."

I gave him certain instructions to be carried out, also advised a more extended trial of the faradic current, as Brenner's formula had been obtained by its use in our first experiment with his deaf ear. This, it is true, is rather like a confirmation of Schwartz's second conclusion, "that Brenner's normal formula is obtained in absolute deafness;" but there must be no tinnitus, for we have no such result in cases where there is absolute paralysis of the auditory nerve.

The following are the conclusions of the nine cases reported: four were cured, two much improved, two improved, one not improved. The one not improved was a form of deafness accompanied with distressing noises, where the patient was apparently in sound health a few hours before; this was followed by apoplectic symptoms, with giddiness, and was due to hemorrhage into the labyrinth, and is known as Ménière's disease. The same results, shown in another from injury, may occur from fracture through the bony labyrinth by contre-coup. In one we had absolute paralysis of the acoustic nerve, with little or no tinnitus.

PULSATING TUBULAR NOISES.

"Nolet,¹ of Leyden, has made experiments concerning the origin of pulsating tubular noises which have been so much discussed, the main results of which are here given, because they are important. Vascular or pulsating noises are produced in tubes of equal calibre, if the velocity of the current be great; and this velocity must be the greater the smaller the diameter of the tubes and the smoother their walls. The rougher their walls are, the sooner will noises be produced. If there be a strictured place in the tube, a noise becomes perceptible already at a rate of velocity when there would be no noise perceptible if the narrowing were not present. When the velocity of the current was considerable, a quivering was to be felt before and behind the strictured place, which was more readily produced in tubes with thin walls than in such as had thick walls. When the tubes were partially widened, noises were produced in them by a greater

¹ Tröltzsch, *Ohrenheilkunde*, Fifth (German) Edition, p. 507. Nolet of Leyden (see *Archiv für Heilkunde*, 1871, xii.).

velocity of the current [? translator]. The noises are produced by the viscidness (vertices of the fluid), and not by vibrations of the walls of the tubes nor by rhythmical friction (?) of the out-flowing jet."

The treatment of such pulsating noises is of two kinds: first, constitutional treatment, if the disease depends upon thinness of the blood or a want of certain elements; these must be supplied, —if from want of iron, by chalybeates; if from want of fibrin, by wheat, etc.; if the other important elements are wanting, blood in some form itself, as the expressed juice of beef, like Valentine's, or by lamb's blood taken warm. If the blood is too thick or viscid, it must be reduced by salines. If the noises are very distressing, resort may be had to nervines and agents that will control the violent action of the heart, as aconite, digitalis, with chloral hydrate or fluid extract of valerian, *Prunus virginiana*, or water of the bitter almond or orange-flower. Mechanical means are also to be tried, by compressing the jugular vein over the highest point of the hyoid bone. The observations of Benedict, Türk, and Politzer confirm us in the opinion that pressure over the mastoid apophyses would, in some instances, modify these subjective noises. By removal of the narrowed condition of the meatus auditorius, as performed by Larrey and Cloquet, or by some mechanical and surgical means as related in the author's work, p. xvi. In a certain class of cases of chronic catarrh of the middle ear, Politzer has recommended the closing of the external meatus by wax or cotton charged with wax. Schwartze employed for the same purpose a ball of gutta-percha, oiled, softened by means of warm water, or, as the writer prefers, gas-heat and olive oil. Lucae has employed and recommended the rarefaction of the air by fitting the external meatus with an instrument like Siegle's pneumatic apparatus, especially in catarrh of the cavity of the tympanum. The condensation of the air in the auditory canal by the same instrument gives, sometimes, good results in cases of pressure of the stapes, or stirrup, over the fenestra ovalis, or oval window.

Then follows puncturing of the membrana tympani, recommended as early as 1722, and first received into favor as a legitimate operation in surgery about the year 1800, for deafness and sounds in the ear. We have repeatedly performed this operation, and in certain cases with success; again, we have operated with no relief to the noises. Schwartze, who has performed this

operation over one hundred times, has established it in cases where there has been an accumulation of mucus, blood, or pus. He prefers a transverse incision in the posterior and inferior part of the membrana tympani. Lucae¹ has also resorted to this operation in the treatment of deafness and noises, by a division of the posterior fold or pocket for the purpose of reducing the tension of the membrane of the drum. Where he has had the peculiar rattling sound denoting a collection of secretion, which is also to be perceived by a sufficient transparency of the membrane, after cutting the posterior fold, he extends the cut to about the middle of the membrane, in order to facilitate the escape of the not unfrequently very viscid and tenacious secretion. He has performed this operation (division of the posterior fold) up to 1870 forty-eight times in forty-five cases, as follows: First, in cases without demonstrable adhesions, fourteen operations; greatly improved, seven; a little improved, seven; not at all improved, none. Second, in expressed otitis media adhesiva, twenty-seven operations; greatly improved, five; a slight improvement, eleven; not at all improved, eleven. Third, in genuine catarrh of the cavity of the drum, at the same time letting out the secretion, seven operations: of these, six were greatly improved, one a slight improvement. Politzer performs the same operation by incision of the posterior fold (not pocket) of the membrana tympani. His incision is a longitudinal one, at right angles to the long axis of the fold between the short process of the malleus and the peripheric end of the fold.² Of the operation of tenotomy we have already given our experience in the cases reported.

SECOND SERIES OF CASES OF TINNITUS AURIUM.

THREE HUNDRED AND SEVENTEEN CASES OF EAR-DISEASE, IN ONE HUNDRED AND SIXTY-SIX OF WHICH TINNITUS AURIUM EXISTED AS A PROMINENT SYMPTOM.

The very frequent concurrence of tinnitus aurium with certain local lesions has, of late years, attracted much attention; to us, it had been for a long time a subject of special study. Having, after prolonged observation, concluded that the subjective symp-

¹ Dublin Journ. Med. Sci., October, 1871, p. 322.

² Monatsschrift für Ohrenheilkunde, Jahrgang ii. p. 51.

tom was not of reflex origin, as the rule, or in the majority of cases, we expressed this opinion in a paper, which we presented to the Philadelphia County Medical Society in March, 1874. It was published in the *Philadelphia Medical Times* for June, 1874, and reprinted and passed through two editions, as it was one of the earliest monographs on this subject. Following this were the *brochures* of Field (London, 1875); Theobald (Baltimore, 1875); the younger Itard (Paris, 1877); Woakes (London, 1877); and Hemming (1878). Toynbee was by no means satisfied with the prevailing ideas of the pathology of tinnitus; and the lamented James Hinton, after quoting Politzer in support of this view, states (in the supplement of Toynbee's work on *Diseases of the Ear*), that it would be better, therefore, that the cause of tinnitus should be held as yet a very open question. Reviewing the field in the light of later experience, we could see no reason for changing our opinion that, in the great majority of cases, tinnitus aurium is by no means a sure indication of brain trouble, nor can it be frequently ascribed to congestion of the labyrinth, nor to auditory neuritis, except as an evidence of long-continued irritation of the terminal filaments of the nerves; moreover, we had repeatedly proved that many of these cases are curable. Mr. Field, in his paper, arrived at the same conclusion, and thought that "the mischief can always be traced to the membrana tympani;" and reported seventeen cases benefited by faradization. My opinion was that the subjective noises always have their origin in an excitation of the terminal filaments of the auditory nerve. Dr. Theobald had made an ingenious attempt to explain the production of tinnitus in accordance with physical principles, when it occurs as a symptom in chronic catarrhal inflammation of the middle ear, and obstruction of the external auditory canal; but he did not distinguish more clearly between the different classes of sounds that occur in tinnitus. The pulsating sounds are rarely, if ever, associated with chronic catarrhal inflammation, but generally accompany the acute and subacute forms. Since these pulsating sounds vary in intensity, but are uniformly increased by any means that increases the intracranial circulation, this points conclusively to the relation which the cerebral blood-supply bears to the tinnitus as a prominent factor in its production. In a table, containing observations from three hundred and seventeen cases of ear-disease, carefully registered by competent medical assistants, and, for the most part, from our own

examinations, we find one hundred and sixty-six had tinnitus; out of which there were but four of a pulsating character; while there were sixty-six in which the sounds were like escaping steam, variously described by the patient as "hissing like a steam engine," "hissing like steam from a tea kettle," "buzzing," "whizzing," or "fizzing;" or "pounding," "knocking," "hammering," "weaving," or the "rattle of machinery." In twenty-two, the noises sounded like the "ringing of bells," "tapping like a drum," or "ticking like a clock." Twenty-three had roaring sounds, "like the noise of the sea," "action of the surf," or "the sound heard when a sea-shell is brought close to the ear." Seventeen had continued noises, such as "humming like a fly or bee," "singing of voices or of birds," and various musical sounds. Finally, came the rarer forms of throbbing and pulsating; these terms being applied according to the degree of violence of the beat. The local disorders accompanying these cases were: first, thickening of the membrana tympani, alteration in the position of the handle of the malleus, generally caused by sinking (retraction) of the membrane from otitis media catarrhalis, subacute or chronic; of such was the largest number of cases, *i. e.*, sixty. In the next class, the cause was otitis externa (or impacted cerumen), which contained forty-five. The results of chronic catarrh of the middle ear formed a third class, in which there was also acute or chronic inflammation of the membrana tympani, with ankylosis of the articular surfaces, thickening and hypertrophy of the mucous lining of the middle ear; of these there were seventeen instances. Lastly, there was a rarer form of throbbing and pulsating, with hyperacusis and dizziness; of these there were two throbbing and four pulsating. Some of this latter class required special mention; in Case No. 64, there was acute inflammation of the middle ear, with hyperacusis. In Case No. 193, there was an angioma cavernosum, involving the left auricle and supratemporal region, in which the pulsation was increased when lying down, or under extraordinary muscular efforts. In Case No. 225, the right ear only was affected, as the result of otitis media specifica catarrhalis, the membrana tympani as white as paper, the left handle of the malleus adherent, and the membrane retracted. There was throbbing in both ears of No. 283, the left one being affected with acute otitis media, accompanying periostitis, and with a small perforation. In two remarkable cases that we had recently seen (one sent by Professor Da Costa, the other by my

son, Dr. Charles S. Turnbull), there was in both cases a peculiar whistling and puffing sound (aneurismal thrill), caused by an aneurism of the branches of the internal carotid and of the temporal branch. In two others, there was disease of the heart (valvular), accompanied by a tinnitus that was of a "jumping" or "roaring" character. The existence of mucus, serum, or pus in the middle ear or Eustachian tubes often gives rise to noises of a gurgling kind. A *résumé* of this subject showed that the greater number of cases of tinnitus aurium result from some change in the membrana tympani, Eustachian tube, or middle ear. In only a few cases was the disorder of nervous origin, and in nearly all of these it was not primary, but reflex. In cases of true pulsating tinnitus, the trouble is not in the intracranial circulation, nor even in the labyrinthine vessels, as was for a long time believed, but it is due to pathological conditions outside of the brain proper. Adopting the etiological classification sustained by the careful investigations of Greene and Fisher, of Boston (commencing as early as 1832), and subsequently endorsed by Jurasz, Epstein, and Hemming, we have the following: 1. Physiological murmurs in the internal carotid dependent upon partial stenosis of the carotid canal. 2. Pathological murmurs in the internal carotid, probably caused by reduced vascular tension, dependent upon disturbance in the vaso-motor system. 3. Pathological murmurs from aneurism of the vessels of the head. As a symptom of cerebral disease, tinnitus occurs only rarely; out of 1652 cases of ear trouble, treated at the Massachusetts Eye and Ear Infirmary at Boston, by Drs. Blake and Shaw, tinnitus aurium was found to be associated with brain disease in only six. The fact that tinnitus can be produced by slight physical changes in the ear is also in favor of their direct production. Even swallowing with closed nostrils, by changing the degree of atmospheric pressure, and varying the tension of the membrana tympani, will produce these noises, as was first shown by Massiat, and subsequently by Dr. J. P. Cassells. In the cases that we have reported, it would be seen that a large number had permanent change in the membrane, with collapse, adhesion of the membrane to the promontory, or disease of the middle ear. It also showed the great importance of the proper treatment of the upper air passages, for in a large proportion of such cases, the mucous membrane covering the turbinated bones is so thickened, swollen, and hypertrophied as to prevent the air from reaching the

Eustachian tube through the nostrils. In the comparatively rare form of nervous tinnitus, which, as we have stated, are generally reflex or pathological in character, there not unfrequently occurs giddiness as a prominent symptom, and such cases have been called auditory, or labyrinthine vertigo. A very good illustration of this is found in a case given by Dr. Hughlings Jackson. The patient, three months prior to his admission into the London Hospital, was attacked by severe vertigo and vomiting. These attacks having recurred several times, he applied for treatment. He was not aware of any deafness, but testing the hearing showed that he was entirely deaf in the right ear. Syringing the canal brought away a piece of tobacco which he had soaked in rum and placed there twelve months before, to relieve an earache, and which he had subsequently forgotten. He had only one slight attack after the meatus was cleaned. Epidermic exuvial masses may in like manner impinge upon the membrane, and, limiting its motion, will give rise to both deafness and tinnitus. This has also been mentioned by Politzer, who refers to cases of this kind, that resisted medical treatment, but which were speedily relieved by dropping in the meatus some emollient, and subsequently syringing with warm water; the truth of which we have often had opportunities of confirming in our own experience.

I made use of some of Dr. Weber Liel's ideas in my work on "Tinnitus Aurium," 2d edition, advising in certain forms tenotomy of the tensor tympani. He was the first who clearly pointed out the great importance of the palato-tubal muscle, and that patients who suffer from progressive deafness have antagonistic contraction of this muscle. A recent case of deafness after an operation for cleft palate was reported by my son, and it was only overcome by prolonged and persistent treatment. In Dr. W. Liel's valuable work, "Progressive Schwerhörigkeit," Progressive Deafness, he gives a most accurate account of the complicated anatomical and physiological relations of the Eustachian tube and its muscles. These facts have been confirmed by others. Credit is due to Dr. Woakes, who directed the English reading physician more particularly by dwelling clinically on parietic deafness, in his work published in January, 1879. Then in a paper read by the same authority before the Otological Section of the British Medical Association, and which was discussed by Dr. Liel and others. Still more recently, in the second edition

of his work, in which he gives full credit to Dr. Weber Liel, as follows: "I find myself quite in accord with the statements advanced by Dr. Weber Liel. The cases observed by me and discussed in the paper referred to, present some striking points of divergence from the disease described by this author as 'progressive deafness,' and which divergence will be apparent by the tabular comparison of symptoms given below, of the two classes of cases."

SYMPTOMS IN PROGRESSIVE DEAFNESS (WEBER-LIEL).

1. Paresis of palate muscles connected with middle ear.
2. Characteristic signs in palate.
3. Antagonistic contraction of tensor tympani, inducing:
4. Depression of membrana tympani, with indications of permanent retraction of tendon of tensor tympani, coming on slowly.
5. Deafness, slight at first, gradually increasing, with intervals of abatement.
6. Noises, constant.
7. Giddiness, recurring at intervals, a constant symptom.
8. Progress, slowly, to complete deafness, but curable in early stages.

SYMPTOMS IN PARETIC DEAFNESS (WOAKES).

1. Paresis of tensor palati and lavator palati.
2. Characteristic signs in palate.
3. Paresis of tensor tympani (probably also of stapædus).
4. Membrana tympani to remain nearly normal in appearance, but deprived of its "accommodating" power.
5. Deafness well marked from first.
6. Noises, exceptional.
7. Giddiness, absent throughout.
8. Progress quickly to recovery.

There is arranged in tabular form, by Mr. Hemming, the varieties and causes producing tinnitus.

KIND OF NOISE.	CAUSES.
1. Tidal "to-and-fro" noises, like the sound produced when a shell is held to the ear.	Tobacco; chronic catarrh of the middle ear, ending in undue contraction of intrinsic muscles.
2. Humming or buzzing noises, like the sound of a humming-top or the buzzing of a bee.	Impacted cerumen, eczema, foreign bodies or parasites in the external meatus.
3. Gurgling or bubbling noises, as of air bubbling through fluid.	Fluid in either (a) the tympanum, or (b) the Eustachian tube; the result of catarrh.
4. Rustling or crackling noises.	Deficiency of cerumen; (hairs in the meatus or on the membrane give sounds like an Æolian harp); acute catarrh in its later stages.
5. Constant rushing noises, like the falling of water in a cataract.	Venous congestion of the labyrinth.
6. Pulsating noises, often said to be like the beating of a drum; frequently synchronous with the pulse.	(a) Extra-aural causes, anæmia, aneurism, etc.; (b) Arterial congestion of the labyrinth.

CHAPTER III.

THE IMPORTANCE OF TREATMENT OF THE NASO-PHARYNGEAL SPACE, TONSILS, AND UVULA, IN ACUTE AND CHRONIC CATARRH OF THE MIDDLE EAR.

It is a well-recognized condition that affections of the nasal mucous membrane are readily propagated to the contiguous sinuses, to the pharynx, middle ear, or by continuity of passage, along the Eustachian tube, the orifice of which is in close proximity with the outer posterior margin of the nasal passage. If we look downwards and inwards, this is best seen by a *rhinoscopic examination*,¹ which is accomplished by placing the patient as in laryngoscopy (the head is well thrown back, mouth open and tongue depressed, with a gag or strong metal or rubber spatula); then with a powerful reflected light, from a large-sized concave mirror, secured on the forehead, so as to leave the hands free, the light is directed on the naso-pharyngeal space, either to the right or left. The tongue depressor is introduced by the hand, and the tongue firmly depressed, but not against the teeth or too far back

¹ A Clinical Manual of the Diseases of the Ear, by Laurence Turnbull, M.D., p. 252. "Rhinoscopy," Philadelphia, J. B. Lippincott & Co.

on the dorsum, else gagging will ensue. With the free hand—the mirror¹ being gently warmed over the light and before being introduced—see that it is not too hot by touching the skin of the face; it is then passed into the mouth, and guided back into the pharynx between the uvula, and the right or left palato-pharyngeal fold. Be careful not to touch with the mirror the pharynx, or soft palate or uvula, and desire the patient to make the effort to breathe through the nose, else the uvula and soft palate will tend to adhere to the posterior surface of the pharynx, and cause occlusion of the naso-pharyngeal aperture. Carry the mirror obliquely as far as possible, either to the left or the right, as you may desire; then gently depress it, and elevate the handle. By this careful, and at times, difficult manipulation, which requires both time and great patience, a vertical view of the lateral walls of the space above the palate can be secured, and this includes the palato-salpingeal fold covering the levator palati muscle, the Eustachian orifice, and the fossa of Rosenmüller. This portion should be carefully inspected, as in the great majority of cases, pharyngeal disease, when originating above the palate, is located between these two fossæ; these glandular bodies bleed on being touched, and are described by Meyer, of Copenhagen, as adenoid disease,² but I think in some instances they are the ordinary closed glands, analogous to the tonsils in structure, thickened, enlarged, and like bunches of grapes, and are found to extend into the nose and turbinated bones, and apt to be accompanied by inflammation of the naso-pharynx. The most serious complication, according to Löwenberg, is that of otitis media, which he states accompanies almost three-fourths of the cases. If the naso-pharyngeal catarrh has become chronic, the membrane is of a dark flesh color, instead of a bright light red, and is bathed with copious secretion; the turbinated bones are not of a pale slate gray, but a dark red in color and swollen, and looking almost like a polypoid growth. If these bones have been long diseased, they cause an "otitis."

I have notes of more than one case where there has been occlusion of one side of the nose, and there are cases reported where both posterior nares have been closed. Young children, both

¹ Form of Mirrors, op. cit., p. 256.

² See Adenoid Tumors of the Naso pharynx, by Dr. B. Löwenberg, Paris. Translated by H. Macnaughton Jones, M.D., Professor Queen's University, Ireland.

boys and girls, are apt, from the irritation of cold bathing in salt water, to have the nares so swollen and thickened as to cause temporary occlusion and deafness as a result. The nose is best examined by the single-wire speculum of Frænckel, of Berlin, which stretches open the alæ of the nose freely.

Atmospheric influences and injuries of this portion of the body produce disease of the ear, and in many instances deafness, which if not promptly treated, becomes chronic, and requires prolonged treatment. First we have nasal abscess, which may involve the whole nasal mucous membrane, which is in contact with the bone lined by periosteum, and affecting with it the orifices of the Eustachian tube, and the submucous cellular tissue, with subsequent burrowing of pus, followed by thickening and adhesions.

Another troublesome condition is often the result of blows upon the nose in childhood and youth, from bat, ball, and other missiles, driven with force, which prevents the free access of air to the nose, causing the patients to breathe all the time by the mouth, and this dries up the normal secretion and affects the vocal apparatus.

A third and a more frequent form of disease of this cavity is the result of ordinary coryza, better known as cold in the head, arising from cold winds, and sometimes epidemic as "epizootic" or "influenza," which involves one or both nostrils in an acute inflammation, first producing dryness, followed by a free discharge of serum, passing into mucus or into pus, either discharge being more or less mixed with blood. This inflammation, in many instances, extends to the mucous membrane of both the frontal and maxillary sinus, and engorgement of the Eustachian tube by blood, and blocking up of the orifice with tenacious mucus results.

When coryza becomes chronic, it is termed nasal catarrh, and is always accompanied with a hypertrophic thickening of the mucous membrane of the pharynx, and that lining the turbinated bones. In the chronic inflammations, in addition there are found abrasions, ulcers, polyps or warty excrescences, extending to the orifice of the Eustachian tube, and sometimes entirely covering these openings. Again, if this diseased condition is of very long standing, the ulceration may extend to the turbinated bones, and as the result, necrosis and a most offensive discharge; this form is termed "ozena." This disagreeable form of disease of the nasal passages and sinuses, is the result of continued irritation,

which is increased by such diseases as smallpox and diphtheria; also, by such diatheses as the tubercular, cancerous, gouty, rheumatic, and syphilitic. A recent case of this nature, which was promptly relieved, was mainly kept up by an ulceration of the tonsils, the irritation extending into the naso-pharyngeal region, vomer, and ethmoid bone, which has been of six months' duration from a mistaken diagnosis.

In some of the more troublesome forms of relapsing pharyngitis, I can trace a history of diphtheria occurring some years back, of more or less severity. In the strumous, scrofulous, or tuberculous child or adult, I find that history repeats itself in the mother, or perhaps in both father and mother. Thus in two cases now under my care—one a little girl of six and the other a young gentleman of twenty-two, the mother of the first and the father of the second patient had chronic catarrhal discharge from the nose and throat, and were both cured.

In another class of cases, every member of a family has swelling of the tonsils, and in some of them cheesy inflammation of the crypts of this gland, to be quickly set up by sudden changes of temperature or slight exposure, or from errors in eating and drinking, producing dyspepsia or gout in one instance, and rheumatism in another.

The cancerous affections of the throat are more rare, yet there are a few instances in which this disease involves the tonsils and other portions of the throat, and which require prompt removal in the early stage, before involving the Eustachian tube, etc.

ACUTE CATARRH.

Treatment.—The old idea of the treatment of acute nasal catarrh was a hot drink, foot-bath, and being well covered up in bed, and the same holds good at the present day. To produce diaphoresis is the beginning and end of its successful treatment. My preceptor, the late Dr. John K. Mitchell, always added to this treatment a teaspoonful of the old paregoric elixir or tinctura opii camphorata, U. S. P., in a wineglass of warm sweetened water, with fifteen to twenty drops of the vinum antimonii, U. S. P. After the action on the skin has taken place, the patient must be kept in the house for the next day, and drink slops for food, and use occasionally a pinch of a snuff, which has been found to work exceedingly well; its composition will be found on the next page.

Professor Niemeyer advises the use of a Russian bath. This is not always practicable, and the exposure in coming from such a bath will do away with much of the benefit derived from it.

After attacks of nasal catarrh, the discharge from the nose being of an acrid nature, it will cause a variety of aphthæ (*Herpes labialis*), or what is known as fever blisters, which are both painful and, to the female, disfiguring; the upper lip should therefore be smeared with oxide of zinc ointment, and the blisters already formed should be touched with a solution of iodoform, in ether or glycerine, which aborts them very promptly.

In acute and subacute attacks of nasal catarrh, one of the most agreeable remedies is the following snuff, which is not painful like tannic acid or alum when it touches the irritated and swollen mucous membrane. Its composition is as follows:—

R. Morphine hydrochloridi, gr. ij;

Acacie pulv. ʒij;

Bismuthi subnitratiss, ʒvj.

M. et ft. pulv. No. i.

S. Use a pinch every six or twelve hours.

CHRONIC NASAL CATARRH.

In the chronic form of nasal or post-nasal catarrh, the first and most important matter is the removal of all scabs and secretions of an acrid character, so as to bring the remedies in contact with the swollen, abraded or ulcerated membrane. This is best accomplished by the use of warm solutions of the chloride of sodium, potassium, or ammonium, thrown into the nose by the atomizer. If, instead of being moist and full of secretions, the parts are dry, the following applied warm will relieve it:—

R. Ammonii chloridi, gr. iv.-xij;

Aquæ destillatæ, ʒj.—M.

Apply the spray to the nostrils, closing the mouth and giving the head an upward inclination, and let the patient breathe strongly upwards and inwards. If the disease has been caused by scarlet fever or diphtheria, a solution of chlorate of potassium should be substituted for chloride of ammonium, and if the secretion is white-of-egg-like in character, an occasional pinch of the following snuff will help to relieve it:—

R. Pulv. cinchonæ rubræ,

Pulv. sacch. alb., āā ʒj.—M.

S. To be forcibly insufflated twice a day.

Sometimes the powdered sugar is employed at first alone to diminish the irritation of the mucous membrane, or associated with iodoform and tannic acid, one part of the former to six of the latter. When the catarrh is of a very chronic character, with loss of smell and offensive odor from the nose, and where great thickening has taken place, it is then that the inhalation of iodine and carbolic acid is of service. It can be used by having a tube filled at both ends with cotton, and in the middle a few grains of iodine and crystallized carbolic acid. Each end of the tube has a cork which is to be removed when inhaling, and the substances are vaporized by the hand being held around the tube.

In treating chronic nasal catarrh, the cachexia before referred to must always be attended to, and if the patient be anæmic, scrofulous, tuberculous, or dyspeptic, these conditions of the system must be treated. Such remedies as dialyzed iron, quinine, salicylic acid, cod-liver oil, with the hypo-sulphites and hypo-phosphites, are of great benefit. Extract of malt, and a most nourishing diet of milk, cream, chocolate, with rich broths and extract of beef may be needed. I have found the oleo-resin of cubebs a valuable remedy in its alterative effect on the naso-pharyngeal and pharyngeal mucous membrane. I give fifteen to twenty drops on a lump of sugar, three times a day. I have also employed the oil of cubebs with equal good results, as in the following prescription:—

R. Ol. cubebæ, ℥ij;
Syr. acaciæ,
Syr. aurantii cort., āā ℥iiss;
Aq. flor. aurantii, ℥viij.—M.

S. A teaspoonful twice a day in water.

This should be employed for two weeks, and then intermitted for a week. Some authorities¹ prefer the cubebs in powder, but this is very disagreeable to the taste, and is apt to produce dyspeptic symptoms. Dr. Bard,² of Ohio, has good success in recurrent post-nasal catarrh, from the following:—

R. Pulv. cubebæ, ℥j;
Flor. anthemis nob. ℥ss.—M.

This is to be thoroughly mixed and put into a common tobacco pipe and smoked, puffing the smoke through the nostrils; and by

¹ Dr. Beverly Robinson, of New York.

² Dr. Bard, Medical and Surgical Reporter, April 6, 1878.

mixing the chamomile and cubebbs with the mullein it forms a good substitute for tobacco, so as to wean smokers from its excessive use. It should be discontinued if a fresh attack of nasal catarrh sets in, and resumed as soon as the inflammatory symptoms subside.

I have employed iodoform with satisfaction in the ethereal solution (1 to 10 or 12), with a brush, as first recommended by Professor Elsberg, of New York. I have also used a solution of the chloride of gold as a local application, in both subacute and chronic inflammation of the nasal fossa and pharynx.

In one or two cases of ulceration of this region I resorted to, when all other remedies had failed, the pure, moist crystals of chromic acid on a platinum wire, and in diphtheria, nitric acid on a glass rod, with a most happy result in each case.

Tonsillitis or *Quinsy* is a variety of acute inflammation of the tonsils, which is common during the cold damp weather of fall, winter, and spring, and although very amenable to prompt antiphlogistic treatment, it will, at times, in certain constitutions before referred to, reach a high grade of inflammatory action, with heat, redness, and swelling. In some of these cases it will involve every portion of the soft parts of the throat, extending to the submucous connective tissue, and at times involving even the hard palate and maxillary bones. Resolution is brought about promptly; at other times nothing will prevent the formation of abscesses—first in one, then in the other tonsil. This will cause great pain and distress, and will require from one week to ten days before the abscess will discharge spontaneously. Free and deep incisions into the swollen gland will cause free bleeding, and afford prompt relief. When once the tonsils have been the seat of such an inflammation, there is almost always a return of the disease every season until the enlarged glands are removed by nature, by the formation of abscesses, or by the use of the knife.

Treatment.—In an ordinary attack, the throat should be protected from the cold by a flannel bandage, an ordinary domestic gargle, a saline purgative associated with a diuretic, the spiritus ætheris nitrosi and liquor ammonii acetatis, and rest in the house for a day or two. The physician or surgeon is rarely sent for until the disease has assumed a severe character, and attended with pain, difficulty in deglutition, and with so much swelling that the parts cannot be seen. There are two remedies which are, at this stage, often very efficacious; the first is the solid nitrate of

silver, applied freely, and followed by a gargle of chlorate of potassium with acidum hydrochloridum, until the slough separates. The second is the spray from a warm solution of sulphate of copper, twenty grains to an ounce of water, with ten drops of carbolic acid added. This is applied by means of the hand-spray, or better, by the steam atomizer.

When the acute inflammation, to which we have referred, of the tonsil has disappeared, these glands will sometimes return to their normal size of health, but more frequently some inflammation remains to become chronic, and ready at any moment, from slight exposure, to cause swelling, difficulty of deglutition, and with deafness more or less marked.

These glands will also take on the ulcerative process, as seen in the strumous development of small patches in the inner fold and layers. There is a discharge from these patches of a glairy mucus, or muco-purulent fluid, or thick, tenacious, albuminous masses, with more or less odor. In other cases, in individuals of a rheumatic or gouty diathesis, there will be secreted small masses of the phosphates; or, as it is termed, tartar-like material, of a most offensive odor, which will be found encrusted on the teeth of such patients.

In the treatment of enlarged tonsils of children, it will be rarely necessary to remove them by an operation. Scarification, and the application of absorbent materials with astringents, is generally all that is needed. The enlargement and hypertrophy in the child will often disappear about the period of puberty. After the age of sixteen, my rule is in ear diseases, where the tonsils are enlarged and indurated, and where the membrane in the immediate vicinity has taken the same form of chronic inflammation, with thickening of the arches of the palate, discharge of mucus from clefts in the tonsils, or where any small points of ulceration exist, to employ excision of the tonsils always as a preliminary to treatment of chronic deafness, with the above conditions added. I am convinced of the utility of this procedure by an increased percentage of cures in relieving chronic trouble in the throat, and in improving the hearing. A few illustrative cases will demonstrate this fact better than a long argument.

CASE I. *Deafness of six years' duration.*—Philip V. R., aged 33 years. Applied August 5, 1876, for relief from deafness, which interfered with his duties as a clergyman. He is stout and robust,

resides in Minnesota, performing the church work of three parishes, many miles apart, and teaches school besides. He is married, but no member of his family is deaf. At times he is nervous, but this is accounted for by my finding out he was an habitual smoker. His allowance is a pipe or two after breakfast, a cigar after dinner, and one or two more pipes full of tobacco after supper. In this connection I cannot refrain from calling attention to the fact that the use of tobacco is a cause of functional disease of the ear. Dr. Richardson (Diseases of Modern Life), states that he has no doubt that tobacco produces a functional disease of the ear, similar to functional disease of the eye, from the same cause. The specific symptoms affecting the hearing are: first, those of confusion, with inability to appreciate distinct sounds, that are either very soft, or unusually loud. This inability gives rise to restlessness and uneasiness upon the part of the listener, who often asks questions with respect to articulate sounds, which by others present are perfectly and distinctly heard. After a short period there is a sudden sharp ringing in the ears. This may occur during or after smoking. Sometimes, if attention be carefully paid to the subject, it may be discovered that some external noise, very slight in character, such as the ringing of a distant bell, or the whistling of the wind through a chink, or some far-off musical murmur, has produced the sound that is heard with so much intensity. At other times it comes on apparently without any provocation. The man is reading, walking, eating, or is engaged in some amusement, when suddenly there darts through one or the other ear a sharp, shrill, drilling ring, which often seems to come from without, and lasts often for two or three minutes at a time. There is no actual pain during this phenomenon, but great annoyance. The ear is not deaf, and both ears are rarely affected at the same moment. If the symptoms be very much prolonged, it may be attended with giddiness; but in the majority of cases, after running through a commencing, an intensified, and a declining stage, it abruptly terminates.

To go on with our case, the duration of this deafness is *six years* for the right ear, and five for the left. The deafness is still getting worse. The patient has had several attacks of quinsy, but has not had an acute attack for one year. The tonsils were found to be enlarged and swollen on both sides. On the right, rising up so high as to be on a line with the orifice of the Eustachian tube, the left tonsil is not quite so swollen, but it has in it nume-

rous cavities. Both glands are covered with a thick tenacious mucus, which can only be removed by hawking. The membrane lining the pharynx and its muscles was of a dark red color, and bathed in a copious secretion, extending up to the orifice of the Eustachian tube, and Rosenmüller's fossa. He has pain when pressure is applied to the tonsils. The physician under whose care he had been, had stated, after using the well-known general and local remedies, that his condition could be relieved, but not cured. The patient is distressed by humming noises in his ears; these noises are especially manifest when alone.

The meatus is normal, the canal has cerumen in it. The membrana tympani is opaque and sunken. The Eustachian tube is open but narrow, and contains mucus, which is also found in the middle ear.

H. D. R. Ear. $\frac{2 \text{ inches.}}{30 \text{ feet watch.}}$ H. D. L. Ear. $\frac{4 \text{ inches.}}{30 \text{ feet.}}$

In the left nostril there is a filling up of the passage by an enlargement of the left turbinated bone, which is also changed in color, from gray to dark red. The patient has never been sick except a slight attack of intermittent fever, twelve years ago, and this has no bearing on his loss of hearing.

Diagnosis.—Chronic aural catarrh, with disease of the nasopharyngeal space and hypertrophy.

Treatment.—Removal of the enlarged portion of both tonsils, washing away of the mucus, etc. Astringent applications and a gargle. A tonic of bromide of potassium and strychnia was used. The tobacco was stopped. To take away his taste for tobacco I gave him calamus or chamomile to chew, and the leaves of the mullein to smoke; Politzer's apparatus was also used.

Improvement began soon after the removal of the tonsils, and a week's rest of mind and body, with the subsequent use of phosphoric acid.

The hearing by the end of the week was doubled in one ear, and trebled in the other. His throat was better, and his tinnitus had lessened. Since his return home his improvement continued, with the exception of occasional relapses from exposure to cold.

CASE II.—September 24, 1878. Katie S., engaged as a saleswoman in a store, called on me because she finds she has deafness, which interferes with her duties. She is a native of Delaware, and her general health is not good; but she has no hereditary

history of any disease, or of deafness. The patient has suffered very severely from smallpox, which has left its impression upon almost every part of the body.

Both ears are affected, chiefly the left, which has been troublesome for seven years; the right ear for two years. There is no pain in the ears, but there is singing and whistling in both. The case has been under the treatment of a physician for some months. The meatus of both sides is dry and free from cerumen. The right membrana tympani is opaque and sunken, with the malleus injected; the handle is twisted and narrow. The dermoid (external) layer sunken and in folds. The left M. T. not so much thickened as the right; no redness of the malleus until after inflation.

There is chronic naso-pharyngeal catarrh. The tonsils are enlarged, and are covered with small ulcerative enlargements, with muco-purulent deposits. The Eustachian tubes are open but narrow, and they contain mucus. The middle ear contains fluid. Hearing distance of left ear is feeble on contact with a thirty-feet watch. In the right ear the H. D. is $\frac{7 \text{ inches.}}{30 \text{ feet.}}$. A loud tone must be used in talking with the patient. She has had disease of the throat for some time, and this trouble has been increased during the summer from sea-bathing. There is no hereditation.

Diagnosis.—Chronic naso-pharyngeal catarrh, with disease of the tonsils.

Treatment.—Removal of parts of the tonsil that were enlarged and covered with points of ulceration. The apparatus of Dr. Rumbold was used with solution of bicarbonate of soda; subsequently carbolic acid and solution of permanganate of potassium were applied. This was continued each day until the surface began to look normal, and the abundant and abnormal secretion had disappeared. Then followed the various apparatus to relieve the Eustachian tube and middle ear, and to bring them back to a state of health. The treatment of the constitution was not overlooked. The following is a record of her improvement:—

Sept. 27.—H. D. R. Ear.	$\frac{7 \text{ 1-2 inches.}}{30 \text{ feet.}}$	H. D. L. Ear.	$\frac{\text{Close contact.}}{30 \text{ feet.}}$
Oct. 4.	" "	9 inches.	" "
Oct. 10.	" "	10 inches.	$7\frac{1}{2}$ inches.
Oct. 16.	" "	13 inches.	8 inches.
Oct. 31.	" "	17 inches.	9 inches.
			10 inches.

The patient was discharged at her own request, and was to continue the treatment at her home.

CASE III.—September 25, 1878. A. E. C., aged 27. From Ohio, and has come here to be treated for deafness, of seven years' duration. The patient is single. She has but little hope of getting well; her general health is not good, although she is plump. The menstruation is irregular, the act taking place only four or five times during the year, and at its time there is much disturbance of the health. In this case there is a history of hereditary deafness in most of the members of her father's family. I will not tire the reader with all the details of this case, on account of the similarity to the above-mentioned case; it will be sufficient to state that the enlarged tonsils and pendulous uvula were excised. Means were taken to establish the normal menstrual discharge, and to restore the throat and pharynx to its healthy condition. Her hearing when the treatment began was R. ear H. D. only on contact; in the left ear was one-quarter of an inch, with a twenty-foot watch. When she left for home after six weeks' daily treatment, she was able to hear in her right ear $\frac{4 \text{ inches}}{20 \text{ feet}}$, and in the left $\frac{12}{20 \text{ feet}}$, and her watch, a tiny one, was heard for the first time for eight years. She was directed to continue the treatment, under her physician, at her home, full directions having been written for him.

CASE V. *Deafness of seven years' duration.*—This is one of catarrhal deafness, the result of nasal and pharyngeal inflammation, with an elongated uvula. Mrs. E. T. S., aged 34, was sent to me by her physician, September 2, 1878. She is a house-keeper in Philadelphia. She is in good health and married, and has three children. Both ears are affected, but the right is, as she says, the most dull. The duration of her deafness is *seven years*. She has been troubled with abscesses, rheumatism, and lumbago. The meatus of both ears is dry and narrow, from picking at them. The membrana tympani is opaque, and drawn inwards in both ears. The Eustachian tubes are open, but are dry and crackling, with a feeling of fulness when she attempts to inflate them. Hearing distance of right ear, $\frac{5 \text{ 1-2 inches}}{25 \text{ feet}}$; hearing distance left ear, $\frac{7 \text{ 1-2 inches}}{25 \text{ feet}}$. Discharge from the nose, which is increased on taking cold. Throat, pharynx, and uvula inflamed and swollen, and the latter touching the tongue. Her mother, father, grandmother, and grandfather, with two nieces, are more or less deaf. There is a constant rushing sound in her ear, and this noise is increased by lying on the left ear.

Treatment.—Ointment of hydrarg. oxidum flav., to be applied to the meatus at night. Removal of the uvula, and the use of tannic acid as a gargle. Pills of cinchonidia gr. ij three times a day. She has attended the office once a week until December 29th, when the following is the report: Nose and throat are well. The noise, which has existed for seven years, has entirely disappeared. The hearing has improved in the right ear to seventeen inches, and in the left ear to twenty-six inches.

Some of my readers will, perhaps, think that the gain of a few inches, more or less, of hearing power by a deaf person, is not much of a success, and yet these few inches may be of the utmost importance. For instance, to a school-boy or girl, in hearing the teacher; or a lady, in shopping, is able to do without a trumpet, the use of which is always disagreeable and painful to a sensitive person. The slight improvement of the ear in the deaf is as necessary as to give the blind the faintest glimmer of light, or sufficiently so that he may be able to go about by himself, or make himself able to read by the aid of the strongest glasses. No one considers it a disgrace to wear spectacles, but few are even willing to use a hearing-trumpet.

Again, by treatment, a few inches of gain of the hearing power, as tested by the watch, is not always a measure of the great improvement of the patient, for the voice has many tones, and the hearing is assisted by the use of the eyes and lips.

ADENOID GROWTHS.

My opinion, since my return from Europe, is that the diseased condition of the post-nasal space termed "adenoid growths" is not as frequent as it was supposed to be by Dr. Meyer, of Copenhagen, who was the first to draw attention to the disease, in a paper published in October, 1869. In the clinic of the University of Vienna, Dr. Gruber had no case on his list. I went to Paris and met Dr. Lœwenberg, in consultation. I most certainly thought this gentleman, who published an exhaustive treatise on the disease, would be able to show me a number of cases; but in three visits to him he was unable to show me a single case. Again, when I went to Edinburgh, I was most kindly invited to visit the Ear Clinic of the Edinburgh Royal Infirmary, by the surgeon in charge, Dr. Kirk Duncanson, and was much interested in his cases, but he had no case of this disease. In London, Dr. Mackenzie showed me every attention, and also gave me a note

to his chief assistant, Mr. Mack Howell, who is medical officer and registrar of the Hospital for Diseases of the Throat and Chest, with its tens of thousands of cases; and in all their large number of instructive cases, of which I examined over one hundred, there was but one case of "adenoid" disease in the hospital, and this one had been operated upon by Dr. Edward Woakes. In our own clinics at the Howard and Jefferson Hospitals the number of cases of this peculiar form of disease have been very few—say, from 1879 to 1880, not more than *three* well-defined cases. There are numerous cases of hypertrophic development of the granular structure and acinose mucous glands, but no pendulous projections; but these are very different from a case of "adenoid" disease, which is made up of growths varying in size from a pea to some as large as a pigeon's egg, and when the finger is placed back of the soft palate they resemble an irregular, soft, pendulous mass, and are aptly compared by Dr. Meyer to "a bunch of worms." Opportunities of seeing true cases are rare, and when only known by a description we are apt to confound them with the form of post-nasal catarrh associated with chronic inflammatory enlargement of the *pharyngeal tonsil* which occupies the vault and a portion of the posterior wall of the pharyngo-nasal space. It is to the researches of "Luschka" that we are indebted for the most complete description of this organ, and to Dr. Andrew Clark, of London, who in the London Hospital Reports of 1864, accurately described the disease, and who also proved that the secretions, when healthy, had the power of converting starch into sugar and assisting in digestion. We fully believe that the tonsils are placed there to assist digestion, and when healthy perform their function up to the age of thirty; after that time they are not as active, and then reduce in size.

HYPERTROPHY OF THE ERECTILE TISSUE OF NARES, VOMER, AND
TURBINATED BONES,¹ AND EXTENDING TO THE ORIFICES OF
THE EUSTACHIAN TUBES, CAUSING DEAFNESS.

These abnormal enlargements of the erectile tissue are found on both the anterior and posterior surfaces of the nares, vomer, and turbinated bones, extending to the pharyngeal orifices of the Eustachian tubes. The color of these structures is a deep red at

¹ Published in the Transactions of the Medical Society of the State of Pennsylvania in 1873, by L. Turnbull, M.D.

the base, shading off to a lighter pink, or to a yellowish cast at the apex. Numerous instances have fallen under the writer's notice. They are first to be recognized by deafness, and a nasal voice, with sniffing. Upon looking at the nose, even without a bivalved ear speculum or mirror, there is found more or less swelling or puffiness of the mucous membrane of one side, the elevations being filled with fluid. In some instances there is so much enlargement as to fill up the whole cavity, and the patient is able to pass but little air through that side. By the use of the bivalved ear speculum, this swollen membrane can be seen to extend even to the inferior turbinated bones. A still better plan is to employ Thudicum's double-valved speculum, so as to perform anterior rhinosecopy. As this instrument holds itself in the nose by a special arrangement, both hands of the operator are free, and with a hand or head mirror, the nasal aperture can be illuminated so as to see much more perfectly. By means of posterior rhinosecopy we will find these enlargements extending into the pharyngeal openings of the Eustachian tubes, the vault or roof of the pharynx, and the upper portion of its posterior and lateral walls.

We report two illustrative cases of a large number we have treated:—

CASE I.—A. W. W., aged eleven years, son of wealthy and very intelligent parents, was brought by his mother with the following history: "A." has enjoyed very good health during the summer, but was liable in the winter and spring to catarrh, which always affected his voice; he has generally been able to continue his studies until he removed from the city to the seashore. In May, 1872, he was sent home with a note from his teacher that he was not able to hear. He has had most of the diseases of childhood, including scarlatina; is of a languid temperament, and very nervous. The only member of the family deaf was an aged aunt, who had been treated by the writer for an eczematous affection of the external meatus. In the boy's case the deafness was only noticed in the month of May, and was accompanied by a buzzing sound in the ear.

Examination.—Mucous membrane of pharynx, soft palate, and tonsils enlarged, and covered with granulations, some small and others large. Mucous membrane of right nostril swollen and projecting like a polypoid growth, and closing the nostril like a

valve; was of a dark-purple color, and evidently filled with effused fluid. Posterior rhinoscopy showed mucous membrane of turbinated bones swollen and granular, and this condition extended into the pharyngeal orifices of the Eustachian tubes of both sides. External meatus—no excess of cerumen, but the dermis covering the walls was injected and very sensitive when examined by the speculum.

Membrana tympani of right side drawn very much inwards from loss of intra-tympanal air; handle of malleus seen, but injected with blood. Left not so much drawn inwards. Eustachian tubes of both sides open, but admitting very little air, with some mucous râles.

Watch Hd., right ear 2 feet $\frac{2}{3}$; left 4 feet $\frac{4}{5}$. Must be spoken to in a very loud tone of voice, and his attention aroused before he can understand. Treatment from May 23 to June 27, visited every third day, local application made every sixth day. Powdered tannic acid dusted into nose and posterior nares, so as to reach turbinated bones and mouths of Eustachian tubes. Use of double stream of air by nostrils to keep open Eustachian tubes, and remove mucous accumulations.

Home treatment.—Chloride of ammonium with chlorate of potassa in mixture with mucilage and extract of liquorice. Local hygiene, salt bath with friction, plain substantial diet, no sweets. Milk diet and flannel covering to the skin. Thudicum's douche was administered by mother or nurse, with solution of salt and water, and later a solution of sulphate of zinc and glycerine.

End of June, Hd., right $\frac{1}{3}$; left $\frac{1}{5}$. Voice improved in tone, not so nasal; mucous membrane reduced in thickness. Ordered to continue treatment, which he did until July. Had a relapse in December, when a free incision was made into the swollen membrane of the nose, which bled very freely for two days; he then used powder of gallic acid, and has had no return since; his hearing is almost natural.

CASE II.—Samuel P. E., aged $5\frac{1}{2}$ years, was brought by his father January 20, 1873, an intelligent and well-educated physician. The history given by him was as follows: The first symptoms of deafness were noticed five months previous, and had increased as the weather became colder, slept in a low bed, no heat in the room, and weather extremely cold. Has tried all

the ordinary means for relief, such as syringing, blistering, etc., but with no benefit. Child pale, delicate, has had but few of children's diseases. The condition of the ear was much the same as in the former case, so that it will not be necessary to take up the valuable time of the reader in repetitions. Hearing distance, ordinary watch, right three inches, left five inches. The treatment was the same, except that the author had the assistance of a physician to carry them out, and the incision in the mucous membrane was made at once. He returned to report in April; Hd., left ear $\frac{1}{3}\frac{3}{8}$, right $\frac{1}{3}\frac{6}{8}$. In the nostrils the polypoid looking growth had entirely gone; voice natural; was directed to use as a tonic, spray of solution of sulphate of zinc, and inflation of the nostril through a piece of tubing, and slight counter-irritation with tincture of iodine, until the hearing was normal. The father informed me that the cure was permanent.

Some of the cases required more than one operation, and in only one case had excessive hemorrhage. This was a young actor brought to me by the late Dr. Maxwell on account of loss of voice and deafness. The bleeding continued in spite of the use of ice, Monsell's solution, and compression for many hours. When checked by the nose it would pass into the trachea until I was compelled to employ Bellock's sound and a sponge charged with powdered alum and the string attached to a piece of wood in front by the nose for twelve hours, but the operation was successful in relieving his voice and deafness.

Some years later Dr. Henry J. Bigelow, of Boston, in an article in the *Boston Medical and Surgical Journal* for April 29, 1875, states that he has found "a remarkable and well-formed cavernous structure at least upon the middle and inferior turbinated bone. The difference in size of the distended and collapsed cavernous bodies is quite striking, and is best seen upon the inferior collapsed turbinated. The outline and dimensions are nearly those of its attenuated, bony framework. Distended, it becomes an angry, turgid mass of uneven surface and livid color, completely closing the lower nostril. A pouch-like dilatation projects from the rear of the bone, increasing its length and with the aid of a blowpipe readily showing, on section, to the naked eye cavernous cells. It is this reticulated pouch that is seen with the mirror at the back of the nares. Above is seen the middle turbinated mass similarly distended, and if the injection of the whole membrane is considerable, the nasal septum also

swells to nearly the thickness of one-quarter of an inch. If inflated and dried, the cells project upon the surface. A section gives further evidence of a cavernous structure with juxtaposed cavities, tolerably uniform in size and equally distributed; approaching quite nearly both the mucous surface and the bone. They communicate by irregular apertures with minute bands, and septa traverse and connect their common walls.

"This erection and collapse is a physiological fact in the normal condition, and is intended to purify the tidal air passing in respiration from all impurities, and so protect the pulmonary organs against disease. The hairs in the vestibule of the nostrils and this erectile tissue are faithful sentinels to arrest impurities in the respired air. By a constant irritation of this erectile tissue by impurities in the respired air, by a mechanical irritation caused by a constant and forcible blowing of the nose in chronic catarrh, the effect of which is felt on the ear producing deafness, and one anterior part of the inferior turbinated bone just within the vestibule, a hyperplasia is thereby set up, which results in so thickening this tissue that normal respiration is very much interfered with, and in some cases entirely prevented. To the above causes may be added in many cases a constitutional predisposition to catarrhal conditions."¹

Dr. Goodwillie, in this special catarrhal condition, when it has passed medical treatment, says it is only to be relieved by the following surgical interference: The hypertrophy of the erectile tissue on the turbinated bones is removed by means of the galvanic or thermo-cautery. To the Paquelin cautery he has devised a new handle, which is held between the two fingers and thumb. He condenses or forces the air by the hand balls. He prefers the galvano-cautery when used in the nose. The vestibule of the nostrils is protected from the heat by a shield made of glass and asbestos. The lower part of the shield is flanged so as to be easily held between the fingers. The top of it embraces parts to be cauterized. The electrode, when heated to a high heat, is passed through the shield on the parts to be removed. After the operation the patient is positively forbidden to blow the nose for the first twenty-four hours, as a preventative measure against hemorrhage. After that time the nose is freed of clot and mucus by means of dressing forceps and the nasal douche.

¹ Surgical Treatment of Naso-Pharyngeal Catarrh. Paper read before the American Medical Association by Dr. D. H. Goodwillie, June 3, 1880.

Then the powder of iodoform and camphor is blown in, covering the entire mucous surface of the nose.

Abstract of Goodwillie's six cases.—In the first case, hypertrophy of the erectile tissue of both inferior turbinated bones. Removed the anterior part of the hypertrophy on the inferior turbinated bones by the thermo-cautery, and the posterior part by the galvano-cautery under anæsthesia produced by nitrous oxide. Cut some adhesions at the Eustachian tube opening. After six weeks' treatment the respiration was fully restored and voice much improved. In case second, there was "loss of singing voice from hypertrophy of erectile tissue on inferior turbinated bone." The hypertrophy was removed by means of the cautery in three operations under nitrous oxide. The patient now looks hale and hearty, and voice regained its strength after having lost it for three years. Case third, hypertrophy of tissue on inferior turbinated bones, with deviation of cartilaginous septum. Removed oval section one-half by five-eighth inch of bend of septum with an excising nasal forceps; one blade contains a circular or oval knife and the other is flat against it, when it cuts its way through the septum. Six months after this first operation removed a small pedunculated polypus from right nostril posterior to the section; also by the cautery the hypertrophy on left inferior turbinated bone without an anæsthetic. Two months after, respiration good, and catarrhal discharge very little. Cases four, five, and six are deviated septums. In one the septum had been dislocated by the force of the thumb against his nose when he blew it; the bent portion was removed by the excising forceps. In the other, denuding the soft parts, pushing them back, and amputating the septum. In case sixth operated under an anæsthetic, removing hypertrophied tissue with galvano-cautery, and the deviation and exostosis by means of the revolving knives and surgical engine, and the patient breathes, sleeps, and eats well.

CHAPTER IV.

ARTIFICIAL PERFORATION OF THE MEMBRANA TYMPANI.

THE subject of the safe removal of foreign substances or fluids from within the cavity of the tympanum or middle ear, in cases of deafness, is one which has always attracted the attention and exercised the ingenuity of many careful observers.

These intra-tympanal substances may be, for convenience, divided, according to their nature, into three classes or groups, viz:—

First. Serum, mucus, muco-pus, pus, and blood.

Second. Fibrin (semi-organized), polypoid granulations and growths, and phosphatic deposits.

Third. Connective tissue, and fibrin (organized).

It is almost unnecessary to dwell upon or to state the amount of danger that the above conditions may cause, but, as we pass from the first to the third, we observe that the ratio of risk to the organ of hearing proportionately increases.

The question as to the source of these products then arises, Why are such substances found in the tympanum? Simply as the retained products of inflammation. Retained, because of their being rapidly poured out while the surrounding parts are swollen, or the Eustachian tube may be occluded, either permanently, as in stricture, or temporarily, from congestion or œdema of its mucous investment.

If we consider for a moment the small size and peculiar construction of the middle ear, as well as its highly important function, we can measurably estimate the injurious influences of even a stasis of the natural secretion of the parts.

In acute "otitis media," we have, as is well known, the pouring out of the fluid portions of the blood. It is not necessarily accompanied by aching pain, but always associated with unusual sensation and swelling.

If it should be, as is frequently the case, catarrhal, then we have what aurists generally call "otitis media plastica," or "exudativa." In the course of a few hours the intra-tympanal, as well as the tubal mucous membrane becomes swollen, the bloodvessels pour out serum, which, with the extra amount of the natural secretions of the parts, completely fills up the middle ear, and

sudden deafness is the result. While the patient feels a fulness in the ear or ears, unconsciously he attempts inflation by the Valsalvian method, or accidentally he forces some air into the tympanic cavity, and the fluid or semi fluid substance therein contained becomes filled with air-bubbles, whose successive escape subsequently causes a continuous crackling sound, which is very distressing to the patient. Pain, as has been already indicated, is not always present, and was wanting in at least one-half the number of cases coming under my observation.

Such acute cases call for immediate treatment, by operative interference, and, moreover, are also among the most successful, and yield the most brilliant results. The cure follows quickly, on the favorable prognosis, and redounds greatly to the skill of the aurist.

If the inflammation is of a higher grade, and the secretion assumes a purulent character, "otitis media suppurativa," mere local applications are of little avail; it becomes our duty, when the tympanum is full of pus, to provide it a means of escape. Such cases are accompanied by more swelling than those just considered, and are always accompanied by pain. If not evacuated by the surgeon, the pus may find its way through the membrana tympani, by ulcerative process.

Time is an important element, as regards the prognosis and result of such cases. Should the exudation become partly or wholly organized, there is but little hope of success from any line of treatment.

Should a small cavity like the tympanum be filled with a jelly-like mass, it can be readily imagined that the functions of the parts will be seriously interfered with, and it will become self-evident that it is of primary importance in the treatment to remove the foreign substance.

Where possible, the air-douche of Politzer may be used to dissipate fluid collections within the tympanum, the force of the sudden rush of the incoming air acting mechanically in displacing the morbid material. The Eustachian catheter may also be employed, but I have found it, in such cases, of comparatively little service, as sufficient force cannot be given to the stream of air injected, while in about two-thirds of the whole number of cases treated by the first method I have found that a few (two or three) blasts of air, from a good Politzer's bag, were sufficient at each daily sitting.

When, however, from the density, or inspissated character of the contained fluid, we find that Politzer's douche is ineffectual, we must resort to the operation of incision of the membrana tympani, the subsequent use of the intra-tympanic catheter, by which means I have been successful in several most important cases.

Another important operation has been performed by Kessel and two by De Rossi. It consists in freeing the stapes from its connection with the chain of ossicles if it interfere with its vibration. This is done by making a hole in the membrana tympani, and disarticulating the anvil in the incudo stapediac articulation.

At this place I will report the clinical notes of three of the most interesting and instructive cases, each treated by a somewhat different method. They were not operated upon by the myringotome, however, but with a long-handled, delicate knife, designed to make a round opening; by this expedient we are also enabled to enlarge the incision in the membrane. This cannot be done so well by the ordinary cataract needle, especially in cases of plastic inflammation with tenacious exudation, as in "otitis media hypertrophica,"¹ but the needle may be conveniently used where the secretion is liquid.

The three cases which are reported will illustrate three classes, and are given in detail, not for the specialist, but for the benefit of the intelligent and well-educated general practitioner, to prove that this is a legitimate and justifiable operation, which should not be neglected when the proper cases present themselves. In the second case the fact is shown that by long and careful treatment good, and even successful results may follow without using the knife or needle. It must, however, be borne in mind that if the proper cases are not selected, any operation will only increase the patient's risk, without any commensurate benefit. In certain other cases, by an operative procedure the patient will have "acute otitis media" set up, which may extend to the brain and cause death. Two cases were communicated to me recently by a distinguished young surgeon. The first was a young lady with catarrhal deafness, who, by the use of "Poltitzer's" air-douche and local treatment, had her hearing increased from four inches to twenty; to hasten this improvement a perforation was made,

¹ For full details concerning the symptoms and general treatment of this form of ear disease, please see "Clinical Manual of Diseases of the Ear." Philadelphia: J. B. Lippincott & Co. Pp. 176-183.

which has never healed, and the hearing not only went back to the four inches, but has become worse, in spite of all his care and treatment. The second was a young German, who was going West, and was brought for treatment; so desirous was the surgeon to hasten this case that he punctured his membrana tympani at once, with the hope of a sudden cure, but instead of cure he unfortunately lost the little hearing remaining in that ear, and had to go West, after ten days' treatment, with the wound open, and liable to take cold in it from exposure in travelling.

CASE I.—*Plastic inflammation of the mucous membrane of the middle ear, involving Eustachian tubes. Removal of a small portion of material by incision of the membrane, with decided and continued improvement.*

M. D., aged 22, a professional male cook in a large hotel, where he was exposed at all times to a heated and moist atmosphere. In March, 1875, soon after having his hair cut short, he was suddenly seized with deafness, and with a filling up of his right ear and nose, as he expressed it, which greatly increased. He did not at that time apply for treatment, but in July, 1876, the humming sound became so intense that he could not sleep, and he had to give up his occupation. He was so deaf that he was unable to hear, except when spoken to in the loudest tones. He then visited the University of Pennsylvania, and was informed that he had catarrhal deafness; but finding no relief, he soon discontinued his attendance. The man employed some domestic and also quack remedies, with but little or no relief. He then applied at the Howard Hospital, March 7, 1877, when the physician employed Politzer's air douche, and also some local remedies to his throat, etc. This treatment was continued for some time, but not much benefit resulted. From his statement, and the annoying subjective symptoms, the white or grayish spotted appearance of the membrane, and the want of the moist sounds of catarrh, I made up my mind that there was some foreign matter there that wanted removal. There was no bulging of the membrana tympani. I therefore, on March 7th, assisted by Dr. Gilmer, penetrated the membrane with a small delicate round-pointed knife, near to the foreign matter, which was in the vicinity of the handle of the malleus, and enlarged the opening downward, so as to give a free exit. There were but a few drops of very tenacious mucus forced out by the Eustachian catheter.

I did not use Politzer's air douche, for fear of forcing the secretion from the orifice of the tube into the middle ear, and through the perforation; nor did I syringe by filling the meatus with warm water and soap, but employed a weak solution of potash, one grain to the ounce of water, from which I found much benefit. He had considerable pain at the time, which was almost immediately relieved. He began to improve, as he stated, immediately after the operation, getting rid of that suffering and distressed feeling, and experiencing great diminution of the noises. On the eighth and ninth of March he was treated by my son, Dr. C. S. Turnbull, who found him much improved, and reintroduced the catheter, etc. On the tenth he had a return of his distress, accompanied with dizziness, which was soon relieved by the introduction, by means of the catheter, of the vapor of chloroform. March 13th, doing very well; hearing distance, right ear, $\frac{1}{2}$ $\frac{5}{0}$ in. watch; left ear, $\frac{1}{2}$ $\frac{6}{0}$; feels so well that he wants to go to work; his hearing, for the human voice, was very much improved, but still had some irritation and swelling of his tonsils and uvula. Compound tincture of iodine and glycerine was applied to the tonsils, and a gargle for his uvula and throat.

CASE II.—*Case of mucus in the middle ear, with deafness, removed in part by Politzer's air douche, and with the intra-tympanic catheter.*

Elizabeth L., aged 24, a bright, intelligent young lady; a seamstress; residence Chester County, Pa.; single; general health good; both ears affected, but the left ear the most. The presumed cause of the deafness was cold. Has had all the diseases of childhood, but no severe disease of late. Has pain, with dryness and itching in the ears, with noises of a crackling or snapping character. Her physician had given her medicines to drop into the ear, for the relief of the pain and noises. The meatus was found normal, no excess of cerumen; membrana tympani opaque, like a ground window glass. Left ear more opaque than the right. This opacity changed its position by the movement of her head. Eustachian tubes plugged with mucus and collapsed. This tenacious mucus extended into the middle ear, as determined by the otoscope. Hearing distance, right ear, $\frac{1}{2}$ $\frac{2}{5}$ in. watch; left ear, $\frac{2}{2}$ $\frac{9}{5}$ in. Has chronic pharyngitis, and back of pharynx the glands were enlarged, and her voice

was nasal. There are also small ulcerated spots near the orifice of the Eustachian tubes.

Treatment November 16th, 1875, to December 6th.—Astringent gargle and cleansing douche, using warm water and common salt, followed by glycerine and water. Internal, pills of sulphate of cinchonidia, three grains each, on account of pain in her head, with half drachm doses of bromide of potassium. Also elixir of valerianate of ammonia for nervous symptoms. Local applications to the throat, excising the glands, painting them with iodine and glycerine and sulphate of copper.

Dec. 6. The discharge from the ulcerated surface of the throat collected in the Eustachian tubes was more tenacious, and we were less able to use Politzer's air douche, which, nevertheless, increased the hearing to $\frac{3}{5}$ in the right ear, and left to $\frac{3}{5}$ in. The patient then left for the country, and wrote as follows:—

13th. "I fear I have taken cold since returning to my home, as my throat is sore, but it does not have any effect on my hearing yet, and I hope it will not, as it still continues to be better; the noises do not change much, though I think they are not quite so persistent, and not so far in the head, but more in the ear, the left ear especially (persons cannot help admitting that I am benefited by your treatment). There is not any of that confused feeling in my head now that was there when I first came to you."

27th. "When I wrote you last I was suffering from a cold, which increased, and remains with me yet. If I was only as well as when I left you, I should be thankful. I think my hearing still better than when I came to you. The noises are somewhat louder, but they do not annoy me so much. I am still using the medicines. There is a very unpleasant feeling of dryness in both ears; the ulcers in my throat I have been watching and trying to keep away by using what you gave me (a solution of cupri sulph.). They were in my throat first, where the Eustachian tube connects with the throat, and I could see them by means of a mirror; allowing the sun to shine in my mouth and holding my tongue down with a spoon, I touched them with a piece of cotton moistened with the preparation you gave me. By this means I keep pretty clear of them."

I received no communication from my patient until February 14, 1876. "I am still following your directions, having omitted but one day. Shall I continue the use of them until I return to

the city? My hearing is about the same as when I wrote you last; the noises are pretty loud in the left ear." I directed her not to return until mild weather. She came on in July. After a week's treatment I noted the Eustachian tube on right side was swollen at its orifice, and was plugged with mucus. Inflation with the catheter and balloon improved the hearing distance on that side to $\frac{3}{5}$ ft. The hearing continued to improve by inflation, with now and then application of electricity to the tubes. Both membrana tympani are sunken, and the tinnitus in right was diminished by drawing, with Siegle's pneumatic otoscope, the membrane outward.

After continuing the treatment for some time, the result did not satisfy me, so I resorted to the intra-tympanic catheter, and with a closely-fitting brass syringe, withdrew a plug of mucus, much to the patient's relief and my own satisfaction. She states that the noises are so much less that they no longer annoy her. The hearing distance is now up to $\frac{5}{5}$ ft. right; left $\frac{5\frac{1}{2}}{5}$ ft. There is also more moisture in the ear and it feels more comfortable. Both membrana tympani look better, both in position and color. She was directed to take tonics, good diet, and cod-liver oil, which she states have acted like a charm; was also directed to avoid cold feet or exposure to draughts of air.

CASE III.—Case of perforation of membrana tympani following an acute attack of "otitis media catarrhalis," the perforation remaining open six months after.

F. M. T., aged 22 years, student. Resides in Connecticut; single; both father and mother living, but has lost two brothers with phthisis, and the mother's family more than one member by the same disease. General health good; robust. The patient is well developed, yet subject to cold, followed by a bronchial cough. The ear most affected is the right; presumed cause, influenza. This was followed by intense pain, fever, bulging of the membrane, and blowing noises. Treatment, acute stage; pain relieved by hypodermic of morphine; leeching, hot water application, with Politzer's air douche, to inflate the middle ear, and ultimately puncture membrana tympani, with discharge of muco-purulent secretion for some weeks; by the use of mild astringents and cleanliness the discharge diminished, so as not to be at all offensive, but is sometimes troublesome, and if neglected the hearing becomes diminished on that side. Six

months after, membrana tympani opaque, eieatricial tissue, with small, irregular perforation along the handle of the malleus. By force, air passes through the perforation with a whistling noise. The right Eustachian tube is obstructed, so that the patient cannot inflate it, on account of mucous plugs, etc. Right ear hearing distance $\frac{5}{8}$ ft. $\frac{1}{2}$ in. with. Left ear $\frac{2}{3}$ ft. $\frac{1}{2}$ in. By careful treatment, cleansing the ear with a solution of bicarbonate of soda in warm water, and inflating the ear by means of Politzer's air douche, the hearing was increased to double the distance; also, by the use of an artificial membrane and a solution of zinci sulphas, the ear has assumed a much improved character, but owing to the tuberculous tendency of the patient, it is difficult to heal the perforation.

It should be remembered that a thickened condition of the membrana tympani, which prevents its vibration to sound, may also involve the whole mucous membrane of the middle ear, or may extend still deeper, and include the membranes of the fenestræ.

Perfect closure of the Eustachian tubes would be a true indication for this operation, but, unfortunately, this condition is very rare. I have met with only a few such cases in many years of practice, these being generally produced by syphilis or small-pox.¹

One of the most difficult conditions, after an operation, is to keep the opening patulous, if the opening be in a healthy membrana tympani.

In the last edition of the work of Von Trölsch,² he gives the report of the following modification of the operation:—

"In one case I have tried the following method, with a view of securing a permanent opening in the drumhead; I cut out a triangular flap with my paracentesis needle, the base of the flap being above. This flap I folded back, and pressed against the drumhead, which I had scarified. The flap united to the membrane in healing. The opening had not decreased at the end of two weeks, when I lost sight of the patient. I think this method worthy of a fair trial. Repeated puncturing of the flap, and of that part of the membrana tympani to which it is fastened, would, perhaps, insure the result aimed at."

¹ A case of this kind is reported in the author's work, pp. 224, 337. Philadelphia, 1875. There is also one, by Lindenbaum, in *Archiv für Ohrenheilkunde*, p. 295 *et seq.*

² Von Trölsch, *Lehrbuch der Ohrenheilkunde*. Leipzig, 1877. P. 413.

The pain of the operation of perforation is, for the time, sharp, but is usually of very short duration. In a few cases the operation has been followed by severe inflammatory symptoms. It must not be hastily concluded that the patient is permanently relieved after the operation. As relapses are apt to occur, the patient should be kept under observation for some time; many clinical histories are incomplete on this account.

Conclusions.—By a happy combination of operative procedures with the use of Politzer's air donche, solutions of various strengths of caustic potash, to soften the secretion, the careful use of the intra-tympanic catheter, and above all in importance, the proper selection of cases, and the use of boracic acid, to prevent suppuration and entrance of septic matter into the middle ear, my success has been much more satisfactory.

ARTIFICIAL MEMBRANA TYMPANI AND HYPERTROPHIC ENLARGEMENT AND THICKENING.¹

The very first case happened to be one of perforation of the membrana tympani, and he began by showing me his punch, by which he can make artificial drums out of any kind of material. He first determined the hearing distance, which was three centimetres; he then tried with a piece of linen, and this increased it to double; not satisfied, he tried India rubber, gold-beater's skin, court plaster, but none did so well as the simple muslin, which he likes very much, as he can put on it ointment of any kind. In a second case, a young girl, he tried the rubber cloth, and shortly her hearing power was increased from $2\frac{1}{2}$ centimetres to 30. He showed me several cases of hypertrophic enlargement and thickening of the drum, and also thickening of the posterior fold, which thickening he treats by free injections into the middle ear, with tepid solutions of sodium carb., until it bulges outward, and gets into the thickened masses of the membrana tympani, when he perforates the membrane with advantage. In an acute catarrhal inflammation of the middle ear he employs preparations of gelatine and glycerine, morphia one tenth of one hundred grains, and various other agents, which, he says, not only relieves pain, but improves the otorrhoeal discharge. They are like a little bottle in shape, and if they do not dissolve, which they

¹ Professor Gruber, Ear Clinic, Vienna.

should do in almost every case, he adds a little warm water; but if properly prepared they will dissolve in the secretions.

Weber Liel remarked to the author that after an experience of sixteen years, he is convinced that intertympanic injections have no effect in chronic middle ear catarrhs. If the catarrh extends from the Eustachian tube and from the naso-pharynx, strong injections of a solution of lunar caustic must be used. In collapse of the tube walls, intratubal galvanization is recommended. Weber Liel uses also in cases of mucous and adhesive catarrh a solution of soda for injection into the cavities of the tympanum in connection with air douche. The plan of strong injections of nitrate of silver has been employed with success in this country to the naso-pharyngeal orifice of the Eustachian tube for many years, and was first recommended by Dr. Pomeroy, of New York. All otologists are agreed as to the use of the soda solution in the middle ear, but Dr. Jones, of Chicago, and a few others use strong solutions of astringents to the middle ear, they state, with benefit, but the general feeling of the profession is not in favor of it.

CHAPTER V.

THE MASTOID REGION AND ITS DISEASES, WITH ILLUSTRATIVE CASES.¹

ANY one who has examined a large number of specimens of the human crania, will be struck with the variety of forms of the mastoid process and cells; rarely in the processes of the same individual are they alike. Hyrtl² in an examination of six hundred skulls, only found three in which the occipital bone helped to form the mastoid cells. I have frequently found in old persons an almost complete want of the larger cells, and in a few instances I have found scarcely any cells at all.

The cavity which develops into the mastoid or air cells in recently born children, as a rule, is of considerable size, to which rule, however, there are numerous exceptions. In shape the cavity is a pyramid, one of whose surfaces is directed upwards and

¹ Read by title in the Section of Otology, Congrès Périodique des Sciences Médicales, 6th Session, Amsterdam, September, 1879.

² Wiener Med. Wochenschrift, 1860.

is formed by the roof of the tympanum. According to Schwartzel¹ the cavity is 8 mm. long, 7 mm. high, and it gradually increases in size and changes in form, becoming larger at one end than at the other.

Dr. Hartmann² has called attention to the fact that in twenty-one sections of the temporal bone in children he found the average thickness of the bony walls between the antrum and the posterior fossa of the cranium to be 4 mm., while in twelve temporal bones of children at the age of 1 to 5 years, the antrum was separated from the posterior fossa of the cranium by a bony wall that averaged but 2 mm. in thickness, and in five cases by a bony lamella that was scarcely 1 mm. thick. From his opinion of these measurements he has expressed himself, as regards the origin of the cells: "Since the cavity is again found smaller in later years, this can only happen by a narrowing from the sides, that is to say by an encroachment of the partition walls of the cells."

Pathology.—In very young children the inflammatory process spreads from the tympanum to the antrum petrosum much more quickly than at a later period. There are numerous cases in which symptoms of meningitis arise in a recently born child a few days after the appearance of an "otitis media purulenta." I have found that if the discharge "otorrhœa" is free and not checked, symptoms of meningitis all disappear, but if it is small in quantity and thin and bloody, or if it is suddenly checked it almost always results in the death of the child. If the child is older there is less danger of cerebral affection, as the intelligent child is able to describe symptoms and the ear is treated promptly. In the infant there is nothing to guide us but the cry or the evidence of pain upon pressure behind the ear.

The second stage, *i. e.*, propagation of the extra secretion, particularly when partly obstructed. These forms in scrofulous, tuberculous, and syphilitic children, also in very violent purulent inflammation of the middle ear, are the result of scarlet fever; the large collections of secretion make their way along the mastoideo-squamous suture, forming an abscess behind and beneath the auricle, which either opens spontaneously or is increased in size and the bone is necrosed, as in the following case:

¹ Ueber die Künstliche Eröffnung des Warzenfortsatzes, Archiv für Opien-keep Band vii.

² Ueber die Perforation des Wartzenfortsatzes; Langenbeek's Archiv, Bd. xxi.

CASE I.—A. H., æt. $2\frac{1}{2}$ years. a fully developed child of a healthy, strong mother, but the father is in the second stage of tuberculous phthisis. The child has had a purulent otorrhœa for two years. There appeared a large abscess behind the ear, which for a time was poulticed, until it opened spontaneously. After some months the inflammation subsided, and a loosened sequestrum of bone was removed by enlarging the opening. The child to all appearances got well. About twelve months afterwards a second abscess formed in the same locality and caused the involvement of a larger quantity of bone. The head was drawn down toward the neck on the same side, and the upper part of the neck became swollen, as if the spinal column was involved. The bone, in the second attack, did not come to the surface, nor did the inflammation disappear, but gradually the bone was broken down and a large amount of it was removed by discharge of small particles. Tonics, cod-liver oil, and sea-air were employed to expedite the slow cure.

CASE II.—Henry H., æt. 5 years. A pale, delicate, scrofulous boy was brought to the clinic of Howard Hospital with a large post-aural opening, discharging pus. There were found numerous sinuses with rough denuded bones underneath, but no loosening or detachment of bone, nor was any part movable by the probe or foreeps. He was directed to use an antiseptic wash to the openings. A few days afterwards the discharge had ceased, the temperature had arisen to 102° , the pulse could not be counted, and convulsions and death soon followed.

In this case there was no doubt in my mind that the cerebrum was affected, for there was present persistent pain in the head, vomiting, strabismus, and convulsions of one side.

CASE III.—Mary E. C., æt. 15 years. Her mother, of decided tuberculous tendency, her father is healthy. The girl has suffered from otitis media purulenta of two years, following a cold, and this had gradually improved, with some loss of hearing. She has been at times affected with distressing vertigo, so that if she had not taken hold of some support she would have fallen. She is deaf in the left ear, a rim of the membrana tympani remaining. She gradually became unable to leave her bed; she lay with her head bent forward on her chest, any movement giving her pain and increasing her vertigo. There have been two or three slight

convulsive movements and internal strabismus was present. When the tongue is protruded there is a tendency to the left side. She gradually passed into a state of coma and died.

Without going into the minute details of the post-mortem, it is sufficient to say that there was no abscess or disease of the cerebrum. The cerebellum was softened, and on it there was an abscess containing about two ounces of pus.

These three illustrative cases bear out the facts first announced by Toynbee, that up to the second or third year of life the cerebrum is most frequently affected, corresponding to the anatomical relations, while affections of the cerebellum and the transverse sinuses appear only at a later age.

Our old method was the removal of the sequestra of bone with the knife, probe, elevator, and forceps. A new method has been proposed, called the "Volkmann," in which a small, delicate, sharp, spoon-like knife or gouge is employed. I have had such an instrument made, and have operated in three cases with it, and the result in each case was a success.

Schede, Schwartze, and Hartmann¹ have treated a large number of cases with good results, and the following is Dr. Hartmann's method of operating:—

"An incision is to be made in at the insertion of the auricle, and in such a way that the middle of the incision lies just below the level of the opening of the external auditory meatus. If a fistula is present the incision either passes through the fistulous opening, or is to be united with it by a diagonal incision. In making the incision through the soft parts we must take care not to cut forward, since the surface of the mastoid process passes over into the posterior wall of the auditory meatus, without any sharply defined boundaries, and by passing forward we run the risk of only loosening the posterior wall of the external auditory meatus, and from here reaching the membrana tympani. This rule seems of importance, and should be especially observed where the soft parts are greatly infiltrated. The incision should not be too small, but fully 2 to 3 cm. in length. The edges of the wound should be held apart with sharp hooks, so that after the bleeding has ceased the field of operation can be thoroughly examined."

¹ On the Formation of Sequestra in the Mastoid Process of the Child, by Dr. Arthur Hartmann, of Berlin. Translated by Dr. James A. Spalding, Arch. Otolaryngology, vol. viii., No. 1, New York, 1879.

In all the cases in which I have operated either a fistula was already present or after the soft parts were cut through there was an opening in the bone which could be enlarged with the sharp spoon. In one case only did I have to employ the chisel in order to enlarge the small opening. The granulations lying in front are to be removed with the sharp spoon. If the antrum is opened and laid bare in this way it can be examined most carefully with the probe or with the tip of the finger introduced. If loosened sequestra are present they can be seized with pincers or forceps and extracted, or as proves most suitable, may be pried out with the spoon. The sharp spoon also offers the best services in removing the bone that has become softened by caries. The precautionary measure suggested by Schede, to use the sharp spoon only when the bone is found to be softened to a certain degree, is not to be neglected.

In my operations I have followed the maxim of confining myself in the removal of the morbid parts to what was most needed—*i. e.*, chiefly the removal of the granulations and the extraction of such sequestra as were fully loosened and could easily be reached. It seems then necessary in the after-treatment to keep the wound open by a thick drainage tube, so that in the subsequent days we may have a full view into the depths of the wound, from which now the sequestra gradually loosening themselves may be detached with the probe and removed. It seems also desirable in the latter stage (as has been emphasized especially by Schwartze and v. Tröltsch) to keep the aperture open as long as possible by means of a leaden nail or a short leaden tube, until we are sure that the mastoid process is in a sound condition. The important point in the after-treatment is the regular removal of the accumulated secretion, for which purpose we prefer syringing at first with antiseptic, later with neutral, and lastly with astringent fluids.

Mastoid in the Adult.—¹In the adult the antrum is large enough to admit a small-sized pea. There are small veins through the upper portion of the process which form a medium of communication between the lateral sinus or its branch, the superior petrosal sinus, and the veins on the outside of the cranium. By this communication and close relation to the brain, if pus be formed

¹ Transactions of the Medical Society of the State of Pennsylvania, Vol. XII. Part I.; Dis. of Mastoid Process, with cases, by Laurence Turnbull, M.D., Ph.G.

and cannot find another outlet, death is apt to follow by pyæmic inflammation of the cerebrum or cerebellum. Disease of the mastoid process is divisible into the following forms: 1st. Inflammation of the external periosteum. 2d. Acute inflammation of the lining mucous membrane, followed by filling up of cells with a reddish pulpy material, by accumulation of pus and with caries. 3d. Chronic sub-acute inflammation of the mucous membrane with sclerosis or hyperostosis. 4th. Periostitis, independent of involvement of the mastoid cells.

Inflammation of the External Periosteum.—In the course of an otitis media diffusa, with or without discharge, the mastoid region begins to swell, becomes red, and very painful on pressure. If these symptoms occur in a healthy individual, the mastoid cells are rarely involved. When this same swelling takes place in a tuberculous, scrofulous or feeble adult, the prognosis is not favorable. In the first class of cases permanent relief is given by free depletion, or by an incision with a strong scalpel down through the periosteum to the bone. In the second class the disease almost always involves the deeper cells of the bone, which, becoming filled with pus, produce caries or necrosis. In children such diseased bone must be removed when suppuration brings the sequestrum to the surface, while in the adult an important operation has to be performed—*i.e.*, perforation of the bone for the relief of the patient. The second class or simple congestion of the mucous membrane of the mastoid cells, which we often see in its slightest form in acute inflammation of the middle ear, is most frequently the result of cold, and is to be relieved by cleansing the parts, and by local depletion by leeches, etc. Still, in its most aggravated form, nothing but an operation will relieve it.

CASE IV.—*Illustrating inflammation of external periosteum, with sudden stoppage of discharge; Disease of mastoid process, with discharge from external meatus; recovery*

Martin F., æt. 7 years, a large and robust boy, but of tuberculous family (father and four uncles having died of phthisis), was convalescent from scarlet fever, and was discharged well on March 15. Ten days later I was called in haste to see the boy. There was great pain and swelling behind the ear, over the mastoid process, but no discharge from external meatus. He was freely leeches, and purgatives were administered, and followed by

anodynes to relieve the pain. On the next day the swelling was on the increase, and had extended to the face and eyes, with fever and symptoms of convulsions. It was then proposed to cut down to the bone, dividing the periosteum, as the only means of relief, to which proposal the mother consented. An incision was made about an inch long behind the ear, and as nearly as possible parallel with the concha, which at this time stood almost horizontal. A profuse gush of blood followed, mixed with which was imperfectly formed pus. The wound bled and oozed for three days. The pain was much relieved, and by the use of bromide of potassium and with sulphate of morphia, he was able to sleep, which he had not done for two days. A poultice was applied on the third night, and by the fourth pus flowed freely. This was encouraged, and by the end of the sixth week the wound was disposed to close; but this was prevented, and the discharge continued for four weeks longer, when the wound was allowed to close, as the roughness of the bone had disappeared.

Report several years afterwards: The young man is now 20 years of age, has enjoyed good health since, being able to be out in all weather; is bright and intelligent, and is at work in a cotton mill. His hearing in his left ear is gone; right very good. Over the mastoid cells of the left side there is a depression of a bluish color from loss of bone. Has never had a severe attack since, excepting now and then a slight discharge from the left ear. He has since lost his mother by phthisis.

CASE V.—*Of the same nature, which was not treated.*

James R., æt. 5 years, in 1862 had a similar swelling after an attack of scarlet fever; it opened of itself after long poulticing, and continued to discharge from the back of the ear for twelve months; it then ceased, leaving a deep depression behind the ear with loss of hearing; the boy imbecile and cannot articulate.

CASE VI.—*Disease of the mastoid process; perforation of the membrana tympani; recovery.*

Mrs. A., æt. 35 years, whose case was of the same character as reported in Case IV., was treated in a similar manner with equally good results.

CASE VII.—*Abscesses over the mastoid process in mother and child; similarly treated and both recovered.*

March 25, Thomas N., æt. 5 years, applied at the Howard

Hospital with an abscess over the mastoid process. He was convalescing from an attack of measles. The swelling back of the ear commenced three weeks previously, then subsided, and again began to swell. On examination, there was, besides the swelling, redness and slight fluctuation. There was no discharge from the ear. On informing the mother what was to be done, she replied: "Well, do what you think is right, as you performed the same operation upon my ear, when this child was only ten months old. I was at that time three months under your care and was cured and remain so." I examined the back of her ear and found a deep depression, where there had been loss of bone. Her hearing in that ear was not perfect, but she was not absolutely deaf. The operation was then performed on the boy, when by the aid of the probe, the bone was found to be denuded of its periosteum. Being of a strumous habit, he was ordered syrup of the iodide of iron, a small poultice of ground flaxseed, and subsequently an ointment of the red oxide of mercury, to dress the part and anoint a tent so as to keep it open.

April 1st the wound suppurated freely, but the opening was disposed to close and it was accordingly enlarged and the previous treatment continued, accompanied with good diet and exercise in the open air. By the end of the month he was reported well, wound healed and all swelling had disappeared.

CASE VIII.—*Perforation of the mastoid process; otorrhœa; removal of the necrosed bone; recovery.*

Mary R., æt. eight years, a robust looking child came under my care at the Howard Hospital early in September, 1861. It was reported that she had suffered from scarlet fever of a most malignant type, having been in a state of coma for several days. This gradually passed away when the throat and ears became affected, and a long period elapsed before complete convalescence took place.

Present condition.—She is deaf in the right ear, with a constant discharge of offensive pus, etc. On washing out the parts, the meatus was found to have a white, soft deposit on its surface with granulations projecting from the tympanum through a perforation involving the greater part of the membrana tympani.

A weak wash of nitrate of silver in solution was to be used and the parts kept clean by repeated injections of tepid water

Counter-irritation was to be kept up in front of the ear, and air was to be passed through the Eustachian tube to keep it open and at the same time force any accumulation of pus out from the middle ear. A guarded prognosis was given. Having improved considerably, she ceased attendance, and the writer saw nothing of her until called in haste to see her, a few weeks later. The history received from her father, an intelligent man, was as follows. The Sunday previous, being a very hot day, when the child was sleeping on a sofa, the father, to cool the house, opened both the front and back doors, and thus produced a strong draught of cool air which blew upon the sleeping child. After retiring she was attacked in the middle of the night with intense pain in her ear, so severe as to cause her to scream and at times become delirious. The parents applied a blister and used other means, but the relief was of short duration. When I was called to her she was suffering intense pain, high fever alternating with chills, pulse one hundred and thirty, and there was swelling over the mastoid region, involving the side of the face and eye.

Treatment.—Believing that pus was formed in the mastoid cells and was endeavoring to make its way outwards, requiring only an outlet, I divided the skin, muscle, and periosteum freely down to the bone. On withdrawing the knife, blood mixed with imperfectly formed pus, flowed very freely. A hot poultice was ordered to be repeated every few hours. A saline mixture of citrate of potassa, containing sulphate of morphia, was prescribed to relieve pain.

Four days later, better. Pus discharging from the opening, the incision not being quite free enough, was stimulated by the application of powdered red oxide of mercury.

November.—During this month, visited the case every few days. The opening over the bone being disposed to close, a sharp, hollow steel probe was used to perforate to the surface of the dense bone, and to remove a portion of it.

December.—In the early part of this month the opening was again enlarged and a piece of bone discharged. On the 19th, carious bone was found by the probe to be movable, and by enlarging the wound a still larger piece was removed with some difficulty, the bleeding being very free. A few days after this operation the discharge ceased and the wound healed. There was a deep depression behind the ear from loss of bone; the perforation in the membrana tympani had closed somewhat; the

child was deaf in that ear, but otherwise well, and continued so for several years. The bone measures six-tenths of an inch in length and three-tenths of an inch in width. It is now in the writer's collection, and has been examined by numerous distinguished surgeons.

In the cases above related, which number might have been increased by many others, we have examples of three of the principal forms of disease of the mastoid region, which will be frequently met with by those who devote much attention to the ear, and occasionally by those who pay no particular attention to this special department.

In Case IV. the simple division of the periosteum, with the subsequent application of a blister, was all that was necessary to complete the cure. In the next case it required the second enlargement of the opening and the breaking down of the bone by the application of nitrate of silver.

The third form is of greater danger to the patient, as it involves a large number of cells of the mastoid process. It, therefore, requires a free incision down to the bone, with its removal when in a diseased state.

This operation of perforating the mastoid cells (December, 1861, and published February, 1862) was the first of the kind that had been performed in the United States, so far as the writer is aware, and has been repeated in the following case.

CASE IX.¹—Foreign body, with middle ear inflammation, involving the mastoid cells; operation followed by erysipelas; ultimate recovery.

W. H., æt. 42, a merchant of Mahanoy City, Pa., consulted me in 1877, bringing a letter from his family physician, Dr. L. M. Thompson. The letter stated: "Patient has had a chronic suppurative inflammation of the left ear since childhood, the result of scarlet fever, accompanied with tinnitus of a distressing character, with intense pain over the temporal and mastoid region, extending also to the base of the brain. The pain, which is now almost constant, is accompanied with attacks of oppression and giddiness, particularly when the eyes are directed upwards." While about his business he would, when these attacks were coming on, by picking, or rather forcibly scraping or digging

¹ Transactions of Medical Society, ass. cit., vol. xii. part 1.

into the meatus as far and as deeply as possible, with a pencil, toothpick, pen-holder, or knitting needle, provoke a discharge of pus, which afforded temporary relief. During one of these efforts at relief, and while much interested in his newspaper, he probed, literally dug, too deeply, and an attack of convulsions, followed by a partial paralysis, was the result. Various methods of treatment had been pursued, but the symptoms remained unchanged.

Status Præsens.—Left auricle red and swollen, meatus externus eczematous, discharge thin and offensive, canal narrowed, membrana tympani and ossicles gone, promontory glistening and in places sclerosed. No other details of middle ear to be made out on account of the swollen condition of the mucous membrane and canal. Eustachian tube pervious. Hears a loud voice, but not the watch, even on contact. Pain, on pressure, over mastoid and against the sides of the canal. Right ear normal. No particular throat trouble. Recommended, on his return, to use local depletion by leeches, followed by hot fomentations; also, large doses of bromide of potassium, chloral and morphia, with quinine.

These means afforded but temporary relief to the pain, even after using half-grain doses of morphia, hypodermically, every little while, as well as successive relays of leeches. I then advised a free post-auricular incision (Wilde's) to be made through the integument down to the bone. This was most thoroughly done by his physician, who reported relief obtained for but a few days, after which time the symptoms returned as before. Finally, at the request of Dr. Thompson, the patient returned, to be under my immediate care, and was faithfully attended by myself and son for several weeks. Meanwhile, to be brief, the symptoms varied, at times better, then worse, and finally relapsed into the old condition. Our patient and his friends having grown impatient, I told them there was but one course to pursue, viz., that of perforating the mastoid.

The discharge had ceased, the painfulness and tinnitus had increased, giddiness and more or less delirium were constant, with loss of appetite and symptoms of a general breakdown; so that, after due deliberation and consideration of the just mentioned grave symptoms, we decided, after consulting Drs. Thompson, Collins, Schapringer, and C. S. Turnbull, to operate.

Mr. H. was admitted October 3, 1877, as a private patient, to

the Jefferson Medical College Hospital, and I operated in the presence of Drs. S. W. Gross, J. H. Brinton, Collins, Allis, Wirgman, Poichet, James, and my son. The post-auricular incision previously made had not entirely healed. This I enlarged, and with a strong knife extended upwards, scraping as I went, and pushing the periosteum to either side. The bone was not found soft or abnormally rough. A drill was then applied at a point about a quarter of an inch distant from the auditory canal and below the level of its upper rim, rotating inward and slightly forward. The drill was withdrawn and carefully cleansed at intervals, and but slight force used, on account of the danger of slipping suddenly and breaking down the delicate cancellated cells of the mastoid. This care is necessary on account of the varying depth of the cells, which is apparent even on opposite sides of the same skull.

Upon reaching and opening the cells, no pus, but a drachm or two of an aqueous and dark red colored fluid escaped. The wound was cleansed and sprayed with carbolized ether (kept up during the operation as well), packed with greased lint, and the patient put to bed. No anodyne was required, as the patient was so thoroughly narcotized with the amount of ether which was used. The after-treatment consisted in the regular administration of beef-tea and a nourishing diet, while the use of alcoholic stimulants was avoided. The wound was dressed twice in twenty-four hours, and after the third day a discharge commenced, which continued while the opening was kept plugged with a linen tent soaked in carbolized olive oil. The ear was thoroughly syringed every day. Our patient never seemed to rally, although he grew no worse, but at the end of the second week all hopes were checked by the appearance of an erysipelatous swelling in the neighborhood of the wound. This spread over the ear, cheek, and entire face, but stopped abruptly before reaching the ear of the other side. Repeated doses of the muriated tinct. of iron, iodine locally, with good diet and the attentions of Dr. Poichet, the resident physician, and the nursing of a devoted wife, brought about a favorable result.

Convalescence soon commenced, particularly after a copious discharge of pus from the ear and wound, and just one month after the operation our patient left for home, free from pain, mind quite clear, slight discharge from the ear, wound almost closed, and general condition rapidly improving. Since that time he

has been under the judicious care of Dr. Thompson, through whose courtesy I received many bulletins.

A recent letter from Dr. Thompson says: "Mr. H. has never, since the operation, had enough pain to require even a mild anodyne, and he requests me to state that he has now no desire to dig in his ear on account of any disagreeable feeling; is able to see company, and he took dinner with his family, Thanksgiving day, November 29."

The following is an extract from a letter received from Dr. Thompson, the attending physician, which makes this history complete: "You will well remember with what tenacity Mr. H. insisted upon a portion of a toothpick being lost in the ear. Some weeks ago he withdrew the cotton from the ear, when, to his great surprise and delight, he discovered adhering by dried blood to the cotton, a piece of wood one-half inch long and one-eighth of an inch in thickness. With its discharge the acute pain that had come on recently, ceased. The wood must have passed into the middle ear, and the discharge must have washed it out. No matter what the cause, or what produced the disease, we were justified in performing the operation, as the man must have died had it not been done."

We have repeatedly demonstrated upon the cadaver the following facts which hold good: If the operation is made as usually directed in most of the works upon disease of the ear, viz., "On a line with the upper part of the auditory canal," the incision must penetrate deeply, enter the horizontal or sigmoid fossa or sinus. Again, if a probe be thrust through such an opening made in the cells, it is liable, even when but slight force is employed, to fracture the thin lamella of bone and cut the middle cerebral fossa, which would likely prove fatal. Therefore the knife, gouge, drill, or trephine should be inserted on a line with the superior edge of the auditory canal, but not at the inferior edge, and the opening carried horizontally and a little forward and not upwards. In this way all the vital parts are avoided, and we sooner or later reach the large cells of the mastoid. The after-treatment, in which great care must be exercised in cleansing or probing, constitutes a process which should be carried on every twelve hours.

Notwithstanding the dangers due to frequent anatomical deviations of the bone, the operation, when urgent, is highly to be recommended, and has now become a standard one.

CASE X.—*Inflammation of the subcutaneous tissue of the supra- and post-auricular region, extending into the middle ear from which pus was discharged, which found its way through the posterior wall of the meatus, in which was a polypoid growth; operation and recovery, with an abstract of five such cases.*

E. S., aged forty-eight years, was admitted to Jefferson Medical College Hospital from Chester County, Pennsylvania, April 10, 1879. There was only a brief history brought by the physician who accompanied him to the hospital. Exposure to intense cold in December, 1878, was followed by a succession of swellings back of the ear and ultimately a discharge from the ear. He had been leeches, cupped, blistered, and iodine was employed with other applications to the post-auricular region, but the patient had gradually become worse, was feeble and now had a constant pain in his head. His physician also stated that he believed there was inflammation of the mastoid cells, and that they required perforation.

On examination of the patient in consultation with Prof. S. D. Gross and other members of the staff of the hospital, it was concluded that the cells were not involved. The following was his condition: Slight swelling on the upper part of the sternocleido-mastoid muscle, pain most severe in the afternoon on the upper part of the parietal bone, over which he kept up a constant rubbing with his hand. Examination with the speculum showed a polypoid growth or granulation tumor just within the meatus, which it filled up. After its removal a probe could be passed through the meatus, showing a connection between the posterior wall of the meatus and the post-auricular region, and the pus oozed more freely when the post-auricular region was pressed upon: his pulse was 84, temperature 100°, and this continued, varied but little, until there was a more decided swelling, when the temperature reached 110°, *i. e.*, just prior to the opening of the abscesses.

Prof. S. D. Gross advised blistering behind the ear, these to be followed by poultices, by quinine and iron internally, and painting the region with tincture of iodine; to relieve the constant pain chloral hydrate and potassium bromide were administered through the day, and a local anæsthetic of camphor and chloral to apply to the scalp, and a nourishing diet, with a hypodermic injection of morphia at night. After the application of the blister there was a contraction of the neck, which caused the

head to be held to the same side. The discharge from his ear was thin, light-colored pus with no odor; the ear was kept clean, and Politzer's douche was employed with hydrobromic ether vapor. The hearing had never been much impaired. On the 26th day of April, the patient not improving, Drs. S. D. and S. W. Gross visited the case in consultation with me, and after examination they both came to the conclusion that there was a periostitis and there was pus, and agreed with me that a deep and long incision must be made over the mastoid, which I performed, *under hydrobromic ether*, down to the bone.

No pus followed the incision, but the hemorrhage was very free. The bone was not diseased, nor even roughened in the least. The incision was kept open for some days by a tent saturated with carbolic acid and olive oil, and over the parts a poultice was constantly applied. The following day the patient's pulse was 80, and temperature 99°, pain much relieved, and he was directed to continue quinine and iron in pill form with milk punch and nourishing food.

April 28th, pulse and temperature the same; 29th and 30th, the pulse about the same, was out in ward, and even took a walk in the open air, continued to do well until the 5th of May, when the temperature arose 101½°, pulse 92. The patient was much disturbed with his pain, there was a swelling on a line with the sterno-cleido-mastoid muscle, with a slight chill, and an abscess formed near the point of incision, and was freely opened. From this time the pulse was reduced to 80, and temperature to 99°, he made a slow but sure convalescence, and was discharged well on May 9, 1879.

On carefully studying this case, which at first was very obscure, not having seen it for five months from commencement of attack, when he entered the hospital, and was placed under my care, I felt satisfied that the mastoid cells were not involved, because the swelling was very low down in the supra- and post-auricular region, the pain was never over the larger cells, but high up near the top of the parietal bone, which latter indicated brain abscess, but without other symptoms to confirm it. I therefore considered it a pain of a reflex character from irritation of the small occipital and auriculo-temporal nerve.

On reading the report of cases by Voltolini,¹ in which he di-

¹ R. Voltolini: "Die Acute Zellhautentzündung in der supra- und post-auricular Gegend." Monats. für Ohrenheilkunde, Dec. 1875, p. 789.

rects attention to a *form of mastoid periostitis as undescribed by otological authorities*, I felt sure that this was a similar case such as he described, although there was more disease of the external than of the middle ear, and which may have occurred from the use of irritating applications. The ear, Voltolini states, may remain intact, but may sometimes in the course of the disease participate in the inflammation. "The disease begins with severe tearing pains on one or both sides of the head, which extend to the side of the face and teeth. The pain is sometimes referred to carious teeth by the patient, but later, fever sets in, and the pain becomes localized above the posterior auricular region, the mastoid surface becomes swollen, red, tense, and exceedingly tender. If active antiphlogistic treatment does not relieve these symptoms, the case progresses to suppuration, under which circumstances the best remedy is always the knife." The same rule has always held good in regard to the early use of the knife, which Wilde recommended where superficial periostitis followed an acute inflammation of the middle ear with a sudden checking of the discharge. In the three cases reported by Voltolini all were the result of cold and exposure. In the first case after the use of leeches, which did not diminish the symptoms on the following day, a long and deep incision was made over the mastoid. The pain was almost immediately relieved, the patient slept well and made a good recovery.

The second case was treated by the family physician for a supposed disease of the ear. Being called in consultation, I found the following condition: The region behind and above the ear was swollen, red, and tender; with the exception of a slight swelling on the superior posterior wall of the external auditory canal, the outer ear was normal. The membrana tympani presented no special abnormal appearances, nor was there any evidence of more deep-seated trouble. Three days later, after application of poultices, and after an incision was made above and behind the ear, there was liberation of considerable sanious pus and relief of pain, which relief continued to the termination of the case in recovery.

The third case given did not end so fortunately; the mastoid region became swollen, and the proposal for an incision made by the physician called in attendance being firmly refused, the inflammation took its course. The application of poultices finally induced a spontaneous opening and discharge, with some relief to pain, which still continued in a measure. Nine months after

the first attack the patient was seen accidentally, and we found the following conditions present: The hearing was but slightly diminished, as the patient could easily hear conversation in the ordinary tone. The region behind and above both ears was much swollen and relaxed, pus discharged from the left ear having found its way through the posterior wall of the meatus (as in the case No. 10); fistulous openings in the neck leading upward to the original seat of the inflammatory process, the pus having burrowed on both sides for a distance of from two to three inches before escaping.

Free incisions, opening up the channels through which the pus had burrowed, were made, but a careful examination failed to detect any implication of the bone; this treatment followed by poultices seemed of good effect and the patient improved with nourishing food and rest; on the third day fever set in with increased weakness, erysipelatous inflammation attacked the edges of the cuts and then extended over the scalp, and on the ninth day after the operation the patient died.

A study of these cases (one by Dr. Blake, of Boston, and one by Dr. H. Knapp, of New York¹) and ours reported as above, shows the disease to be neither one of the auricle, the external auditory canal, the tympanic cavity, nor the mastoid cells, but one that originates without, and not within the ear, and one that might progress inward, but would hardly penetrate deeply.

To Dr. Voltolini is due the credit of having given a clear and detailed description of this affection, which has been translated. Dr. Swan M. Burnett and F. C. Hotz have also added each a case to these, the first published in the United States. It is not noticed by Dr. A. H. Buck in his paper on diseases of the mastoid process in the *Archives of Ophthalmology and Otology*, vol. iii. No. 1, p. 179; for in this he states, that "the inflammation of the external periosteum of the mastoid process occurs as a concomitant symptom or phase of an acute inflammation of the external auditory canal," nor is it mentioned in the still more recent works on otology.

Since the discharge of patient Case X. we have received information that he exposed himself for two days to the rain, and had a slight return of the swelling and pain, but the discharge

¹ Report of the First Congress of the International Otological Society. D. Appleton & Co., New York, 1877, p. 80.

has gradually decreased. The physician who has charge of the case was directed to open the swelling and keep it open with a tent saturated with olive oil and carbolic acid, also to wash out the opening with a solution of carbolic acid and water, and to change the form of his tonic from time to time, as the conditions arising might indicate.¹

Within a recent period we have had two most interesting cases under our care, sent us by Dr. Schott, of this city. The brief history is as follows:—

A family of three children, one girl and two boys, were attacked with malignant scarlet fever. After some weeks the girl died, and the other two children were so low as not to be expected to recover, and in the case of the youngest, a boy of four years, there was a persistent tonsillitis, with swelling of the neck up to the ears, and involving the ear and extending to the Eustachian tube and mastoid cells. The elder boy had otitis media purulenta chronica, with perforation of both membrana tympani. After careful treatment for many weeks the boys were sent to me. The elder boy, after a month's treatment of the ears, recovered, and is now able to be at school. The boy of four had otitis media purulenta chronica, with five fistulous openings over the mastoid process, two on the left and three on the right. When these openings were examined with a probe, they were found to contain sequestra. The piece of bone on the left was found to be movable and was extracted January 11th, and very soon one of the openings healed up while we used a simple carbolic acid lotion. The other remained open and the discharge diminished, yet there was found on examination a portion of roughened bone which was scraped by the sharp steel spoon, and cupri sulph. in powder applied. The largest opening on the right side was filled up with a wax sponge tent to dilate the opening, and on January 31, the bridge of tissue was divided and the granulations trimmed away. By means of a strong bone forceps a large sequestrum was removed while the little fellow was under the influence of hydrobromic ether. He is now well, Nov. 26, 1880.

¹ This patient reported himself in person, perfectly well, at my clinic, Jefferson College Hospital, October, 1880, having no discharge, nor has there been any loss of bone.

CHAPTER VI.

THE HYGIENE OF THE APPARATUS OF HEARING, WITH THE PREVENTION OF DEAFNESS.

THE organ of hearing, owing to its great delicacy and to its acting at all times without cessation, is more apt to be injured than any other organ in the body. It is true that it is located within one of the hardest bones and apparently well guarded from direct injury; but unfortunately the citadel has more than one entrance, and by way of the throat enters the greatest number of its foes. The Eustachian tube is an opening from the throat to the middle ear, and it is by this unguarded orifice disease is able to penetrate by every act of swallowing, admitting air which is often charged with disease from the varying conditions of temperature. Almost every disease of the nose, palate, and throat may be transmitted to the middle ear, also the contagious affections, such as small-pox, scarlet fever, and measles.

There is no absolute repose for the ear; it is in action from birth till death. If we compare other organs with it, we can see at a glance how liable it is to injurious influences. The eye, for instance, has its time of rest and repose when night comes, and the light is obscured, or even in the day the closed lids prevent the powerful influence of the rays of the sun. Art has also by its tinted glasses done much to shade it from the noontide glare. The stomach, liver, and heart have each there time for rest. It has been calculated that the ventricles rest twelve hours, and the auricles eighteen out of the twenty-four. The lungs and the brain have also their times of repose from activity.

Of all the injurious influences combined, none, however, are so hurtful to the integrity of the human ear as cold.

Alternate heat and cold, when suddenly applied to the ear, are very injurious, and these alternations of temperature, combined with dampness, produce what is termed an influenza or common cold, or cold in the head, which is sure to produce inflammation in the ear, and the repetition of this same cold alternately, produces a diseased condition of the ears, which by its alterations of tissue, both of the receptive, mechanical, and nervous apparatus, terminates in a form of deafness the most prevalent and difficult to cure, or even relieve, unless seen in its very early stage.

There is another cause which, although not so prevalent, is not less injurious, ultimately, to the ears. I refer to the continued action of sonorous vibrations as seen in the resulting deafness of locomotive engineers, boiler makers, telegraph operators, gunners, millers, and operators in factories.

These irregular vibrations or noises act first by the concussion of the whole body. Second, by the painful impressions constantly produced on the organs of hearing. The first of these two effects only results from constant vibrations, which may be very moderate, producing slight *succussion*, but the hearing loses little by little its tolerance for strong vibrations, and above all for noises. Hence an incessant cause of injury to the delicate apparatus of hearing.

Strong concussions, as sudden explosions in blasting and in gunnery, often produce first rupture of the drum of the ear, or *membrana tympani*, followed by acute inflammation with hemorrhage; also, nervous deafness with all its attendant buzzing, ringing, singing, etc.

PREVENTION OR PROPHYLACTICS OF DEAFNESS.

Delicate, and especially highly nervous persons who are easily frightened, and who suffer from deafness or have a family hereditation, should live apart from the loud noises of railroads, manufactories, boiler shops, mills, etc. They should also avoid with the greatest care the action of cold and damp on thin shoes; avoid walking on damp ground or brick pavements, which latter absorb almost as much as a sponge and retain it. I will here again refer to my work on the diseases of the ear, and make an extract from it, going a little more carefully into some details in regard to the prevention of deafness, and will finish what I have to say by dwelling on the great importance of early recognition and treatment of ear disease.

First, children ought never to be struck with the palm of the hand, even in sport, or punished by boxing the ears, as sudden deafness has resulted, as well as the rupture of the *membrana tympani*. Often the sudden jar or shock or concussion of the air on the ear drives in the stapes or inner bone, destroying its functions and diminishing the sensibility of the nerves. A snowball when thrown with force on the ear, or a sudden accidental blow with a ball or bat, has also been a cause of deafness. A well-authenticated case of a sudden kiss, without the knowledge of

the party, on the ear, injured it for a time, showing how careful persons ought to be.

Teachers should always try a child's hearing before blaming it for inattention, as it is often from deafness. This testing the hearing should be done by placing it at a few yards distance and trying whether it can understand what is said to it, first in a low tone and then in a louder one.

Each ear should then be tested by a watch, the normal hearing distance of which is known, always stopping up the other ear by the finger.

We have already referred to the injurious influence of cold as being the chief cause of deafness. This is to be prevented by avoiding the ordinary causes of taking cold, first taking plenty of fresh air when the weather is clear and dry, using the water which has stood in the room with a sponge on the whole body, and applying friction until a glow is produced, but no water on the head or in the ears; water should never enter the ears under any conditions, unless warm or hot to wash out some injurious substances which children either place in their ears or pass in accidentally. Introducing the twisted corner of a towel is particularly hurtful, as it pushes the wax down upon the membrane. Persons with delicate ears should avoid draughts, or sitting in wet clothes, or becoming overheated when in a close room and then passing suddenly into a cooler atmosphere, as from church, school, concert, theatre, or beer saloon; this latter place is very injurious to a partially deaf person from the heated atmosphere impregnated with smoke and fumes of alcoholic beverages etc.

Smoking is injurious of itself to the ear, and induces a peculiar diseased condition of the Eustachian tube; and open-air smoking should never be indulged in by a deaf person, as it injures the throat and opening between the throat and the ear. Clouds of dust of any kind act injuriously upon the ears, and rain, sleet, or snow should always be prevented from entering the ear. No cotton or wool should be worn in the ears unless there is a perforation of the membrane of the drum. If there is itching of the ears a little vaseline or cosmoline may be introduced on the end of the little finger, or a little cologne water or lead water applied around the external orifice, but never poured in. A piece of sponge attached to a handle should never be used in the ear, nor should a steel pen, earpick, tweezers, bodkins, or pins, as they irritate and scratch the delicate lining membrane and in some

instances pierce it. A large number of persons have permanent deafness with the destruction of the membrane by sudden diving in cold water, or falling in the sea without any protection of the head; the latter should be covered with a straw hat or oil cloth cap.

Sportsmen have the membrane sometimes pierced by a sharp twig in passing through a hedge or woods. The parts should be protected from the air, but no heating fluid poured into the ear. Persons in the wheat and oat fields will take a straw, or beard of wheat or rye, into their mouth, and without being aware of it will let it go down the throat, when it is apt to pass into the Eustachian tube, and it will even work its way through the drum-membrane. Farmers and workers in straw will sometimes get it into the ears, and a sharp straw driven with force will penetrate the drum-membrane. If an insect, grub-worm, or beetle gets into the ear, pour in warm sweet oil or glycerine so as to prevent it breathing, and so kill it, and then get a physician to syringe it out. Never introduce liquid chloroform or ether. If there is pain in the ear always blow in chloroform vapor by means of a tube or a clay pipe filled with cotton. If there is pain laudanum or wine of opium should be used by saturating a piece of cotton or wool and then heat it over a lamp flame so as to drive off all the alcohol or spirits, and then it is fit to be introduced into the ear.

CONCLUSIONS.

1st. The external ear must not be washed except with tepid water, and by means of a sponge, not allowing the hair to become wet or the water to enter the canal of the ear.

2d. During damp, cold, snowy, or rainy weather the ear must be protected by a cap with ear protectors.

3d. If the membrane of the ear is perforated, a small piece of absorbent cotton should be worn, except when in the house or in bed. If there is a discharge with an offensive odor, a wash of four grains of boracic acid to the ounce of warm water should be employed at home with a syringe or Clark douche.

4th. Persons with sensitive or diseased ears should wear the hair long enough to cover them, as this is the natural protection. Frequent cutting of the hair very short is one of the causes of catarrhal inflammation of the ear. The fashion of females wear-

ing the hair and hat on the back part of the head tends to neuralgia and disease of the ear, and should not be followed during cold wintry weather. Persons suffering from deafness, and who have lost their hair, should always protect the scalp by an artificial covering or by a silk or velvet cap.

5th. In piercing the ear the lobule or soft part only should be penetrated, and this by a clean steel instrument, holding a pad of cork on the opposite side. On no account should the sharp instrument penetrate the cartilage, else inflammation will be sure to follow. When ear rings are worn they must never be of mixed metal, but of pure gold or silver, and light in weight, else a sudden pull will lacerate the fatty tissue of the lobule.

6th. The ears of children should never be forcibly pulled or boxed, as before stated, not even in fun, as the flat of the hand comes with great force.

7th. The opening which leads into the membrane of the ear or auditory canal should never be interfered with beyond the distance of the first joint of the little finger, and if there is an excess of cerumen or wax it should not be removed, as stated before, by use of the twisted end of a towel or sponge, for superfluous cerumen should never be forced in, but encouraged out, as that is its natural movement.

8th. As before stated, no sharp steel, iron, or bone instrument should be used to scrape the ear; if an instrument is absolutely required it should be of hard rubber, not sharp, but rounded and spoon-shaped, by which an excess of dry wax can be removed without scratching the canal, care of course being taken not to introduce it further than the first joint of the little finger.

9th. Persons with an exceedingly dry, sensitive skin, which has a tendency to generate masses of fine scales of epithelium or of an eezematous or herpetic character, require an agent to keep the external canal of the ear slightly moist. As the air in contact with the skin dries it up, they should use not sweet oil or any ordinary grease, but a small portion of vaseline or cosmo-line, as we have before recommended, which will be absorbed and leave no extra scales. This will relieve the noises in the ear caused by the rustling of the dry scales, also the itching of the ear.

10th. When the ear has become impacted with normal or altered cerumen, and the advice of the physician is that it should

be washed out, pure water should not be employed, but a solution of bicarbonate of soda or baking soda, a few grains to the ounce of warm water. If, after washing by such means, the hardened matter can still be seen by the physician, and the fullness remains, let the ear be filled three or four times a day with the warm solution, and a plug of cotton used to keep it in, following this treatment by employment again of the syringe. After such washing the ear must be most carefully dried, and a pledget of cotton worn while in the open air.

11th. In swimming or diving the ears of deaf persons, or those suffering from perforations of the drum or chronic inflammation, should always be covered with an oil-silk cap, or a pledget of wool, not cotton, for when the latter becomes wet it prevents hearing, which is absolutely necessary in case of danger.

12th. Persons suffering from noises in the ear, depending upon disease of the labyrinth, or nerve of the ear, from otitis media purulenta, or perforation of the drum membrane, are not improved by sea bathing, and on no account should bathe in the surf, exposing the ear to the risk of being struck by the waves, but should use the warm sea baths.

13th. We have already dwelt upon the injurious influence of the excessive use of tobacco and alcoholic beverages, more especially in persons who are already deaf, and have given examples, in their proper place, of such cases.

14th. Deaf persons, and those who have a tendency to become deaf, should avoid all occupations which would bring them in constant contact with great noises. It would be of little utility to give directions in this part of our subject as to the cure of the diseases of the ear and deafness, and as a little knowledge is dangerous alike in ordinary affairs, it is more so when the life of an individual is at stake. We would, therefore, advise all persons suffering from diseases of the ear not to trifle with themselves, but to apply at once to their family physician, and should he not quite make out the nature of the difficulty he can call to his aid those who can. It is a well-recognized axiom in medicine that, unless the diagnosis is correct, all your therapeutic means or remedies will be at fault. It is true that we can fire into a bush in hopes of killing the bird, but if not seen we may fire and kill our friend the patient who stands behind the bush.

For the benefit of physicians who may not have had the opportunity of calling to their aid a specialist, or who may be in the

country, on board of ship, or in the army, we would refer them to our work,¹ in which will be found an article on "Diagnosis of Diseases of the Ear."

CAUSES AND PREVENTION OF DEAFNESS AND DEAF-MUTISM.²

Consanguineous (or blood-relationship) Marriages as a Cause of Deafness and even of Deaf-Mutism.—This is a subject which should be considered apart from the popular prejudice which is against this form of marriage, and which ascribes all sorts of evil as attending it.

Now what are the evils ascribed to it? One of the most alarming statistical statements that has ever been made with respect to this subject is contained in a paper published by M. Boudin, of Paris.³

"1. Consanguineous marriages in France represent about 2 per cent. of all marriages, while the proportion of congenital deaf-mutes born from consanguineous marriages is to the whole number of congenital mutes: *a.* In Lyons, at least 25 per cent.; *b.* in Paris, 28 per cent.; *c.* in Bordeaux, 30 per cent.

"2. The proportion of congenital deaf-mutes increases with the degree of the consanguinity of the patients; if we represent by 1 the dangers of having a deaf-mute child in an ordinary marriage, this danger is represented by 18 in marriages between first cousins, 37 in marriages between uncles and nieces, 70 in marriages between nephews and aunts.

"3. In Berlin among the Catholics, the proportion of the deaf and dumb is 1 in 10,000; among Christians mostly Protestants, 6 in 10,000; among the Jews, 27 in 10,000. In other words, the proportion of deaf-mutes increases according to the facilities granted to consanguineous marriages by the civil and religious laws.

"4. The census of 1840 showed that in the Territory of Iowa, in the United States, the proportion of the deaf and dumb among the whites was 23 in 10,000; among the slaves, 212 in 10,000.

¹ Clinical Manual of Diseases of the Ear. J. B. Lippincott & Co., Market Street, Philadelphia.

² Abstract of paper on Consanguineous Marriages as a Cause of Deaf-Mutism. By Edward A. Fay, M.A., Washington, D. C. Read before the Third Conference of Principals of American Institutions for the Deaf and Dumb at Philadelphia.

³ Annales d'Hygiene Publique, vol. xvii. pp. 5-82, Am. Annals, Oct. 1876.

"That is to say: among the colored population, where slavery affords facility to consanguineous and even incestuous unions, the proportion of deaf-mutes was *ninety-one times* greater than among the white population, who are protected by civil, moral, and religious laws. . . .

"5. The most healthy parents, if related, may produce deaf-mute children; on the other hand, deaf-mute parents, not related, very exceptionally have deaf-mute children; the prevalence of deaf-mutism among the offspring of consanguineous parents is, therefore, entirely independent of all morbid hereditary influence."

This is certainly a terrible indictment of consanguineous marriages, and if the statistics upon which it is founded were correct it would be entirely conclusive; but M. E. Dally, a fellow-citizen of M. Boudin's, is quoted by Mr. Huth¹ as having established the following facts in a series of articles published in the *Gazette Hebdomadaire de Médecine et de Chirurgie* (vol. ix. pp. 499, 513, 531):—

1. There is no proof whatever for M. Boudin's assertion that "consanguineous marriages in France represent about 2 per cent. of all marriages;" on the contrary, 5 per cent. would be nearer the truth.

2. The statistics given by M. Boudin for Paris were based upon a total of only 67 congenital cases who happened to be pupils in the Paris Institution at the time of his visit, whereas M. Dally ascertained, from the records of all the cases that had been examined thoroughly in that institution, that the proportion of pupils who were derived from the marriage of near kindred was only 5.8 per cent., and from all in any way related up to the seventh degree only 11.7 per cent.

3. The percentage in the Bordeaux Institution was really only 8.4 on a total of 287 families, relationship being noted up to the fourth degree.

4. The Lyons statistics were derived from some merely verbal data given by M. Perrin, the physician of the Institution in that city, to M. Devay; when questioned by a friend of M. Dally, M. Perrin hardly remembered the fact, and said that no register of the Lyons Institution showed whether cases of deaf-mutism resulted from consanguineous marriages or not.

¹ The Marriage of Near Kin, considered with respect to the Laws of Nations, the result of Experience, and the teaching of Biology. By Alfred Henry Huth. London, J. & A. Churchill, 1875. 8vo. pp. 440.

There are some other portions of M. Boudin's statistics, not here quoted, of which M. Dally makes similar havoc; whether he does so with regard to them all we are not informed; but the inaccuracies shown in the case of the French reports must render us suspicious of the figures given with regard to Berlin, which, even if correct, are offset to some extent by those of Nassau, where the proportion of deaf-mutes among the Catholics is greater than among the Protestants. Another explanation, not less probable than M. Boudin's, of the divergent percentages of the deaf and dumb among the adherents of different religious creeds, may be found in the *Annals*, vol. xviii. p. 206.

"As for the Iowa statistics, Mr. Fay¹ easily disposes of them. In the first place, slavery never existed in Iowa. This blunder—one of a kind we have learned to expect, if not to excuse, in the treatment of American subjects by foreign writers—M. Boudin borrows from the less innocent M. Devay,² who, though not unaware of the geographical objections to his argument, compares, in order to show the injurious effects of slavery, the percentage of deaf-mutes among the whites and the blacks of Maine, New Hampshire, Vermont, Massachusetts, Ohio, Michigan, Indiana, Illinois, and Iowa! In the second place,—and this part of the explanation may well be mortifying to us as American citizens,—the returns of the census of 1840 were grossly perverted in the interests of slavery, so as falsely to indicate that a far greater proportion of the free blacks of the North suffered from various physical infirmities than the slaves of the South. Many white deaf-mutes in the northern States were recorded in the census as colored, and afflicted not only with deafness, but divers other calamities. For instance, in one of the counties of the State which M. Boudin selects as affording the most overwhelming testimony to the correctness of his views,³ three intelligent white deaf-mutes, all graduates of the Institution at Hartford, one of them the editor of an influential local paper, had the pleasure of finding themselves published in the census of 1840 as 'deaf, dumb, blind, idiotic, insane, and colored!' The truth is that if the several censuses of the United States prove anything with regard to the influence of slavery upon deaf-mutism, they prove

¹ Edward A. Fay, editor *American Annals of the Deaf and Dumb*, Oct. 1876, p. 204.

² *Du Danger des Mariages Consanguins*, second edition, p. 128.

³ Jones County, Iowa.

just the opposite of what MM. Devay and Boudin would have them, for they show a much less proportion of deaf-mutes among the black than among the white race.

"Another fact important to be considered, in estimating the value of the various statistics which have been published to demonstrate the evils accruing from the intermarriage of kindred, is their remarkable diversity. Mr. Huth quotes fourteen sets of statistics based upon totals of congenital cases of deaf-mutism ranging from 13 to 4458; among these, the percentages of the numbers derived from consanguineous marriages vary from 3.9 to 30.4. It is worthy of note that the highest percentages are based upon small totals, while the large totals, like those of the Irish Census Reports, give only from 6 to 8 per cent. But the great divergencies in the results as a whole certainly detract from their value as evidence one way or the other.

"One factor essential to the satisfactory solution of the question before us has never been ascertained; namely, the extent to which relatives intermarry. If it could be shown that the proportion of consanguineous marriages producing deaf-mute children, to the whole number of consanguineous marriages, is not greater than the proportion of consanguineous marriages to all marriages, and if at the same time it could be demonstrated that in districts where the intermarriage of kindred prevails, the percentage of deaf-mutism to the whole population is not greater than in other districts, it would follow that deaf-mutism is not a consequence of such intermarriage; on the other hand, until it has been established that the proportion of deaf-mutes born of consanguineous marriages exceeds the proportion of marriages of this kind, no one can say with positiveness that these unions are a true cause of deaf-mutism. The proportion of consanguineous marriages to all marriages is variously estimated. Dr. H. P. Peet, 'judging from the number of cases within his own experience,' puts it, with reference to the marriage of first and second cousins—beyond which degree it did not seem to him important to pursue the inquiry—at scarcely 2 per cent. for the Middle States of America.¹

"An argument sometimes adduced against the intermarriage of relatives is the large proportion of deaf-mutes to be found among the valleys of Switzerland, where such marriages are common.

¹ Thirty-fifth Annual Report of the New York Institution for the Deaf and Dumb, p. 92.

In these communities deaf-mutism frequently exists in connection with goitre and cretinism, and the responsibility for the triple affliction is charged upon the kinship of the parents. But it has been shown quite conclusively that goitre and cretinism, the causes of which are better understood than those of deaf-mutism, are due to the poisonous nature of the soil through which percolates the water the inhabitants drink. In one valley where different water was introduced from a distance by means of pipes, these diseases entirely ceased to appear in every family that used the new water. In some of these valleys, moreover, it has long been customary for the young men to seek healthy wives from the opposite side of the mountain; but the new-comers soon get goitres, and their children are often cretins.”¹

The Rev. Samuel Smith, one of the excellent clergymen laboring amongst the deaf and dumb in London, mentions, in the July number of the *American Annals of the Deaf and Dumb*, “the fact of eight children, all congenitally and totally deaf, the issue of the marriage of two first cousins; and many other instances under his personal observation of quite an appalling number of congenital deaf, the children of first cousins.”

In my examination of the records of the Pennsylvania Institution for the Instruction of the Deaf and Dumb at Philadelphia, the number of families from which the pupils are received in which more than one of the children is deaf and dumb appears to be one hundred and forty-seven. In five of these families both parents are mutes. In one the mother is a mute, and has had two husbands, both hearing. She had a daughter by each husband, both of whom are deaf and dumb. In one family there were six mute children.

In the Irish census, in 154 cases where the parents were related in the degree of first, second, or third cousins, the results of these intermarriages were 100 cases, 86 congenital and 14 acquired deaf-mutes, and 4 of these were dumb only, and 4 were dumb and idiotic.

Dr. Peet approved the suggestions with regard to obtaining full statistics; such a course is pursued in the New York Institution. “Another important subject for investigation is that of intermarriage among deaf-mutes; recently the question was submitted to him whether such marriages were likely to result in deaf-mute offspring or not, and upon examining the history of the marriages of this kind with which he was acquainted, he was

¹ St. Lager, *Etudes sur les Causes du Crétinisme*, etc., quoted by Huth, p. 214.

surprised to find that *at least one-half* of the whole number had produced one or more deaf-mute children."

Mr. Wilkinson, of the California Institution, said "we were too apt to jump at conclusions on this subject. We find that the parents of a deaf-mute child are related, and we are immediately satisfied that this is the cause of the misfortune, and ask no further questions. There is no analogy in nature to support the common belief that consanguineous marriages are injurious. The finest cattle are produced by breeding in-and-in. In raising choice cattle regard is had not to the consanguinity of their parents, but to certain points of excellence which it is desired to reproduce and develop. Mankind belongs to the animal kingdom, and is governed by the same natural laws. True, any defect in both parents is likely to be perpetuated and aggravated in the offspring; but if two related persons who are free from defect marry, the result will be offspring superior to the average. We ought not to advocate the enactment of laws forbidding the marriage of kindred, for no facts have been established which justify such laws. If legislation prohibiting the sale of ardent spirits, which are known to be productive of evil results to mankind, is an undue interference with the liberty of the citizen, legislation forbidding the marriage of relatives, the results of which are as yet undetermined, is still more objectionable."

Dr. Gillett said "it was his belief that from 15 to 25 per cent. of all the blindness, deaf-mutism, and idiocy in the world is the result of consanguineous marriages. The statistics of the Illinois Institution certainly show as large a proportion as this with regard to deaf-mutism. He had found great difficulty in ascertaining the truth with respect to such marriages from the parents of pupils; in some cases answers had been given which he afterwards found to be false. He thought consanguineous marriages ought to be prohibited by law."

Mr. Wilkinson expressed the opinion that "Dr. Gillett's estimate of the proportion of cases whose parents were related was far too large. Among the 216 deaf-mute and blind persons who had been pupils of the California Institution, but one family was represented in which there was relationship before marriage. In this instance there were three deaf-mute children; but the father was so deaf that it was difficult to converse with him, and it was far more probable that the affliction was inherited than that it was the result of consanguinity."

Dr. Palmer said "the Ontario Institution was only six years old, but the proportion of the children of cousins was very large; quite as large, he thought, as Dr. Gillett's estimate."

Dr. Gallaudet said "we should remember that, taking society as it exists, the number of persons entirely free from defect is very small, and the probability is that when relatives marry there is some defect common to both which will be perpetuated and intensified. He had not given the subject careful investigation, but he was sure that a large number of cases of deaf-mute children who were the offspring of kindred had come under his observation. He was glad to occupy the position he took several years ago with regard to the marriage of deaf-mutes."

The following is another class of evidence given by Mr. Ackers¹ as to the evils of the marriage of blood-relations:—

"It is a common thing, on inquiring about the pupils at the different institutions, to find that their parents—or some one or more of their aunts,² uncles, or cousins—are also congenitally deaf.

"There are those who think, because the children of some parents, both congenitally deaf, can all hear (though I believe this to be very rare), that the evil of such marriages has been exaggerated. But what is their argument worth? It is worth just as much as that of a person who should attempt to ignore the physical evils produced by drink, because persons have been known to get drunk every night of their lives and yet live to be old. As well might arguments be used against care in sanitary matters because one or two very old and healthy people may be found where bad water and worse drainage prevail.

"But to return; take the case of Martha's Vineyard, Massachusetts, U. S.,³ which was inhabited in the year A. D. 1720 by about two thousand Indians, whose descendants now number about two hundred; among these, strange to say, no case of a congenitally deaf child has occurred—yet we find the alarming number of fully one in every hundred and fifty of the present inhabitants deaf, instead of one in fifteen hundred! or ten times

¹ Deaf and Dumb. A Lecture by B. St. J. Ackers. London, 1876.

² I have put aunts before uncles, as it is a fact, well known to physiologists, that the female transmits marked character, peculiarities and blemishes more often and more strongly than the male.

³ I am indebted for these statistics to the Hon. F. B. Sanborn, of Concord, N. H.,—a great authority in the United States on this subject, and on all questions relating to the statistics of the deaf and dumb.

the usual number. All are descended from one common ancestor, a missionary who went over to the island in the year before mentioned, 1720. He was himself a hearing and speaking person, but one of his descendants was congenitally deaf, and now there are descendants of his to the third generation without hearing whatever."

On the other hand, numerous instances are cited by Mr. Huth of communities in various parts of the world where consanguineous marriages prevail to a great extent, and yet the children are more than ordinarily free from deaf-mutism and other defects. Prominent among these instances may be mentioned the settlement formed by the deserters from the English ship *Bounty* upon Pitcairn Island in 1790; a community in Java, and another in Dahomey; the people of Iceland; and several isolated fishing populations in Great Britain and Ireland.¹

The experiments that have been made in the breeding of animals from the same parentage, have been carried on under conditions so varying, and with results so conflicting, that but little importance can be attached to conclusions derived from this source. They doubtless show a tendency to the reproduction and increase of any disease or taint that may be common to both parents; but if the experiments described by Mr. Huth as having been conducted by M. Legrain were genuine, the closest kind of in-and-in breeding, at least in the case of rabbits, is entirely harmless, provided healthy animals are always selected. It is not denied by the writers who defend the intermarriage of kindred, that family diseases and defects, if any such exist, are likely to be perpetuated and intensified by inheritance from consanguineous parents, just as they would be by inheritance from parents from the most remote and divergent races, provided a predisposition to the same disease existed in each. But it is argued by Mr. Huth that the intermarriage of relatives has this advantage over outside marriages, that in "them one can exercise some selection, since a man generally knows the state of health and the disposition of members of his own family." As an offset to this

¹ In one county-parish of the Province of Pomerania, there are thirteen marriages between the children of brothers and sisters; among their descendants are neither deaf nor blind, with the exception of one who lost his hearing at the age of ten years by cerebro-spinal meningitis. From a paper on Deaf-mute Statistics of the Province of Pomerania and the District of Erfurt. Collected by R. M. Wilhelmi, M.D. Abstract by Dr. A. Hartmann, Archives of Otology, vol. ix., No. 4, p. 307, Dec. 1880.

may be quoted Mr. Darwin's forcible suggestion that "no man knows with certainty, until towards the end of life, what ills may lie hidden in his edition of the family constitution;" and it may be added that couples desiring to marry, whether related or not, are too apt to be little influenced by considerations of this nature, even when well aware that evil results will probably accrue to their offspring.

Many instances where such unions have resulted in sound and healthy offspring are adduced in Mr. Huth's book, and we find others in a thoughtful paper read before the Eclectic Medical Society of New York, in 1870, by its president, Dr. Alexander Wilder. One of the most impressive cases is quoted from M. Alfred Bourgeois, who presents a genealogical table of his own family, in which, in the course of five generations, there were more than eight consanguineous marriages without evil results. Another is from the elder M. Seguin, who gives the statistics of ten consanguineous marriages that have occurred in his family, all of first cousins or of uncles and nieces, with various complications; and all, except one which was barren, producing large families of healthy children. The instances of intermarriage of near kindred mentioned in the Bible, especially in the early annals of Hebrew history, are numerous and striking. Abraham married his half-sister Sarah, and founded a race which, intermarrying continually within itself and often within the limits of close consanguinity, has maintained its existence and vigor to the present day in every variety of climate and under circumstances the most adverse; Abraham's brother Nahor married Milcah, his own niece, and his son Isaac married Rebekah, the granddaughter of Nahor; Isaac's son Esau married Mahalath, a granddaughter of Abraham, while Jacob, his other son, married Leah and Rachel, his own first cousins; Jacob's great-grandson Amram married Jochabed, his own aunt; and the results of this last union following these generations of consanguineous marriages, were Moses the law-giver, Aaron the orator, and Miriam the prophetess.

Wilhelmi¹ calls attention to the following historical facts in regard to "marriages among near kindred." Marriages between

¹ Deaf-mute Statistics of the Province of Pomerania and the District of Erfurt. Collected by R. F. Wilhelmi, M.D., Swinemünde. Communicated and abstracted by Dr. Arthur Hartmann, of Berlin, Archives of Otology, vol. ix., No. 4, December, 1880. New York: G. P. Putnam's Sons.

the children of brothers and sisters were fully permitted by many nations of antiquity, and he points out that in many mythologies the gods wedded their sisters. In the Mosaic law (which we have already referred to), besides the marriages between ascendants and descendants, as well as brothers and sisters, it forbids only the union of the nephew to the aunt (Lev. xviii. 6-8). The Roman rite, too, permits marriages between the children of brothers and sisters; but not, originally, that between uncle and niece. The ancient Christian church, likewise, did not oppose the marriage of relatives. But after some time the Roman Catholic Church insisted upon her right to forbid even those of less intimate relations. The Reformers continued the Catholic restrictions. From Wilhelmi's communications it resulted that 105 deaf-mutes descended from 60 marriages between relations in the Province of Pomerania. These 105 deaf-mutes had 279 brothers and sisters with perfect senses. Therefore 6.4 per cent. of all the deaf-mutes in the Province descended from marriages between relations, and 17.7 per cent. of congenital deaf-mutes.

This whole matter rests not alone upon the obtaining, often from ignorant persons, proper answers to minute and careful inquiries by the superintendents of our institutions for the instruction of deaf-mutes, as the best intentioned persons will mislead unintentionally or from want of knowledge. It is now a well recognized fact in physiology, that if the stock be healthy, free from defects, the progeny will also be healthy; but, if the mother especially have any constitutional defect like insanity, cancer, scrofula, deaf-mutism, or consumption, the children, as a rule, will inherit the bad as well as the good qualities. It is therefore of the utmost importance that the rising generation should bear this in mind before becoming interested, that it is their duty to themselves, their children, and to the community in which they live, to select healthy helpmeets, and thus save their children and themselves from a curse that will attach itself to them and to their latest generation. What other causes produce congenital deafness? Scrofula, cerebro-spinal meningitis, syphilis, typhus and typhoid fevers, and consumption, with inflammation of the labyrinth and brain. A well-marked strumous or scrofulous mother will, as a rule, bring forth feeble and diseased children, having affections of the eye and ear, and if this disease of the ear takes place in utero, the children will be found, as a rule, congeni-

tally deaf. If, however, the male is strong and robust, and free from constitutional taint, even if the mother is feeble, all the offspring are not usually found diseased if a healthy wet nurse nourish the children. A child may suffer in utero from spinal meningitis, and as a rule will be deaf at birth. Syphilitic mothers will bear children who are profoundly deaf or will become so soon after birth. Typhoid fever in the mother will cause the same disease in the infant, and it will be born a congenital deaf-mute. If the mother is suffering from consumption, the child is apt to inherit this condition. Almost all consumptives have disease of the ears, and it is a well-known fact that the majority of the deaf and dumb die from scrofula or consumption.

Accidental Deafness.—Falls, frights, blows, great and sudden noises, zymotic diseases, scarlet and other fevers: Falls on the back of the head often fracture the bones of the skull, and also by concussion of the nerve or effusion of blood destroy the hearing power in the auditory nerve. Again, the internal ear is supplied by the vertebral artery, which lies on the back part of the head, and injuries of the spine and back of the head will cause hemorrhage and entire loss of hearing. Other varieties of falls are on the side of the head, by which the temporal bone, which contains the internal ear, is fractured, and thus irreparable injury is done to the hearing power. Frights: this cause of deafness is from sudden news of pleasure or sorrow, and has in many instances bleached the hair and caused loss of speech and hearing. Blows on the top and side of the head from blunt or sharp instruments are a frequent cause of total deafness. Also so simple a means of punishment as a slight blow on the ear with the flat of the hand will cause permanent deafness by rupturing the drum-membrane, and driving the stirrup or little bone firmly and permanently into the foramen ovale or oval window, and, when this bone is so firmly fixed as not to move, deafness is almost total. Again, boys will strike the ear with hard snow-balls or an ordinary ball, and very recently a blow from a bat in the hands of a friend produced deafness for six months in a young lady. We have already dwelt upon great, sudden, and continuous noises as affecting the auditory nerve; also upon cold, which is the chief cause of impairment of hearing. The skill, or rather, we say, the want of skill, on the part of the physician is properly classed amongst the causes of deafness. As we have stated before in another work on the ear, it is of the utmost im-

portance that in measles, and all forms of disease, the ear should be carefully looked to, if there is pain, deafness, or bulging of the drum-membrane, and more especially during the height of the attack of scarlet fever, the aural speculum and lamp should be used. The close and intimate relation of the throat, Eustachian tube, middle ear, and the brain in acute catarrhal inflammation must be closely watched, not only to save the hearing but life itself. In numerous instances deafness may be averted, if a judicious and skilful incision of the bulging and inflamed membrana-tympani is made, which will give vent to the serum, blood, or pus which is often the cause of the pain and fever. Paracentesis of the drum-head through Shrapnell's membrane, with the after-treatment by warm-water injections, followed by Politzer's method of inflation and the use of chloroform vapor, will relieve the inflammation, diminish the discharge, and stop the intense pain and suffering, prevent deafness, and in many instances save life.

ON BATHING, SWIMMING, AND DIVING, AS CAUSES OF AURAL DISEASE.

Swimming and diving in cold water seem to me to be important and frequent causes of disease of the external auditory canal and of the membrana-tympani, as also of the middle ear, though bathing in river or sea water is, when wisely and properly regulated, both healthful and pleasant. The evils attending bathing and swimming in cold water are caused by the entrance of this cold fluid, not only into the external meatus, but as far as the membrana-tympani, inducing inflammation of the lower portion of the auditory canal, and of the external surface of this tympanic membrane. But a still greater evil is from sudden deglutition, or swallowing, during diving or swimming, by which—the mouth, nose, and pharynx being filled with cold water, and the mouths of the Eustachian tubes open—a portion of the water passes into the middle ear. This result rarely occurs in expert swimmers or divers, but is most common in beginners, who suddenly, from cold, or the shock of the contact of the water, breathe or swallow in a sobbing manner. I have, however, known it to occur in old and experienced swimmers while plunging headforemost, owing to the intense coldness of the water—the act of deglutition being entirely involuntary.

If the water is not removed by placing the head to one side,

and drawing the external ear forcibly outwards, shaking the head at the same time and opening the mouth, it is apt to cause inflammation, with the formation of pus, followed by perforation of the membrana-tympani; or the inflammation, if neglected, may pass inwards to the cochlea and labyrinth, and implicate the brain, or terminate in death.

It is a well-recognized maxim among those who devote special attention to diseases of the ear, that no cold fluid should be allowed to enter even the external auditory canal; still this important fact is not sufficiently recognized by the profession at large. The entrance of warm water into the ear is less objectionable, but even this is not quite free from danger, and has its disadvantages; and the water should in all cases contain a few grains of a saline ingredient, like borax, soda, or common salt, when employed in washing out the ear. The symptoms of water in the middle ear are, in the first stage, an uncomfortable sensation, followed by earache or pain, which after a time becomes agonizing, and is accompanied with great tenderness behind the auricle. In proof that water in the ears is injurious, and causes deafness, I might cite a number of instances which have come under my own observation, both in males and females, and it is a well-known fact that even dogs which are *thrown* into water become deaf.

Many chronic cases of aural disease, from bathing in the sea, come under treatment during all seasons; but acute cases, from swimming and diving, occur during the summer months, and chiefly in boys from eight to sixteen years of age; a much smaller number occurring in the fall and winter. If the acute form is promptly treated, entire recovery takes place; but should the case not be seen until after the chill, it is always followed by a discharge of serum or pus of shorter or longer duration. In cases not recognized as the result of inflammation of the ear from bathing in cold water, the symptoms of violent headache, furious delirium, and coma give the physician the impression that disease of the brain is present, and the case thus improperly treated terminates in deafness or death. The morbid condition in the first stage consists in acute inflammation of the extremely delicate mucous membrane lining the middle ear. This inflammation is followed by effusion of fluid, and, after twenty-four hours, by the formation of pus; it is in every instance attended by fever, with swelling and inflammation of the naso-pharyngeal space, and great pain. If this

fluid or pus be removed by incision into the membrana-tympani, followed by the use of the air douche, and injections of hot saline water, the patient recovers, and the ear is saved. The patient is apt to remain deaf for several weeks, and the local application of tincture of iodine, with or without some anodyne, brushed around the back of the auricle, facilitates the removal of the inflammatory thickening. To diminish the discharge of pus, should it continue, we may employ a powder of salicylic acid and starch, blown into the meatus and after a time washed out, and reapplied twice a day, until the discharge shall have ceased and the perforation have become closed; or where this fails, we resort to solutions or powders of sulphate of zinc, copper, permanganate of potash (gr. one to five to the ounce of warm water), alone, or with carbolic acid and glycerine if there is much odor. All these measures must be under the care and guidance of a physician or surgeon. For other causes of deafness see author's manual.

CHAPTER VII.

ON THE METHOD OF EDUCATING THE DEAF-MUTE AT HOME, AND ON THE SELECTION OF PROPER SCHOOLS FOR THE DEAF AND DUMB.

THE lot of the uneducated and ignorant deaf-mute is sad indeed; cut off from intercourse with his fellow-man by loss of speech, and unable to obtain instruction or amusement from such intercourse, or through books, he is left to "Nature," and is governed by naught but his animal passions and appetites. It is no wonder then that, when these latter are in full development, he becomes allied to certain of the brute creation. From my own dissections of the brain of the deaf-mute, as from those of many careful observers, it is rendered probable that the deaf and dumb are capable of receiving and retaining as great an amount of intellectual knowledge as their hearing brothers or sisters, provided that adequate instruction be made available through the eye.

As early as the fifteenth century, some effort was made to

teach deaf-mutes,¹ but it is to the seventeenth century that is due the great honor of having been the period of jubilee to the deaf and dumb; and to the Abbé de l'Épée was given the great gift of teaching deaf-mutes by a symbolic language, so that they might know good from evil, have intercourse with a select few of their fellow-men, and, above all, acquire such aspirations after true knowledge as would fit them for a happy home here, and for a better world above. Another devoted man, the Abbé Sicard, who took up the clue already furnished by de l'Épée, adopted sign-language, and enlarged, improved, and reduced it to a system. The knowledge of this valuable method soon crossed the Atlantic, and its advocate, the Rev. Thomas H. Gallaudet, D.D., founded the American Asylum at Hartford, Conn. (1817), and, soon after (1820), M. Clerc (one of the favorite pupils of Sicard, who came over with Dr. Gallaudet) organized the Pennsylvania Institution for the Instruction of the Deaf and Dumb, in Philadelphia. This institution has sent out, since its organization, 1700 pupils, well educated, and with a careful moral

¹ Historical note of the deaf and dumb. In the book of Exodus. iv. 11, and in the book of Leviticus. xix. 14, we have the first records in regard to the deaf: "Who hath made man's mouth? or who maketh the dumb or deaf:—have not I the Lord?" "Thou shalt not curse the deaf." In the year A. D. 685 we are informed² that the Archbishop of York, England, commonly known as St. John of Beverley, taught a deaf and dumb person to speak, by causing him to imitate the motions of the lips and vocal organs of the teacher, and so produce articulate sounds. Eight hundred years after, in the 15th century, Rudolphus Agricola,³ a native of Gröningen, in his posthumous work, "*De Inventionem Dialecticæ*," relates having seen a person deaf and dumb from infancy, who had learned to understand writing, and was able to express all his ideas by that means. Rabelais³ mentions a young Italian, named Nello di Gabrielis, who, though deaf, could understand all that was said to him by merely watching the lips of the speaker. In the 16th century Jerome Cardan, a learned Italian, thought out most of the points now in use in the "French System."

We now pass to Spain. Teaching articulation to deaf-mutes was practised by Pedro Ponce de León, who died in 1584, and his method was first described by Juan Pablo Bonet, in a dissertation published in 1620. In England John Bulwer published a work on the subject in 1648; then John Wallis, savilian professor at Oxford, England, in an appendix to his *English Grammar*, entitled "*Tractatus Grammatico-physicus de Loquela*:" in 1680 George Dalgarno, a native of Aberdeen, published a useful work for the deaf and dumb; and shortly after Juliana Conrad Amman, in his "*Seidus Loqueus*," Amsterdam, 1692, and "*Dissertatis de Loquela*," Amsterdam, 1700.

¹ *L'Éducation des Sourds-Muets*. By Mgr. de Haerne, quoted by B. St. J. Ackers.

² ³ Penny Encyclopædia, vol. viii. p. 326.

training which has been of inestimable advantage to them and to the community at large. Germany was not long after France in this philanthropic labor, for, in 1729, Samuel Heinicke, a Saxon by birth, developed the "artificial method" of instruction for deaf-mutes. The principal aim of this good man was to improve the "French system," and to endeavor to cultivate whatever might remain of speech, by developing the latent power which exists in all save a very few. In the early stage of this system, artificial signs are absolutely necessary; but when these have been acquired, they are to be employed only as a ladder to reach the higher department, where the finger-alphabet and other artificial signs are no longer required. When successfully taught by this system, pupils are enabled to think in the idioms of the language of their country, to hold audible conversation, and so understand much that is spoken to them, being thus rendered practically less deaf, and actually not dumb.

Another advance which has been made in the further improvement of the mode of instruction of the deaf-mute comes from England, in the system known as "Bell's Method of Visible Speech," which, having received but little attention in the country of its origin, was brought by its author to the United States, where it has been received and adopted in seven of our forty-eight institutions, and with the most gratifying results. Many thousands of deaf-mutes have received the advantages of an education by means of the sign language, and of articulation taught by the German method. I would also state that the United States have a "National College" at Washington, where more advanced studies can be pursued, and where young deaf-mutes are graduated with a standing and scholarship not inferior to that achieved by the graduates of ordinary colleges. This institution bears to others for the deaf and dumb the same relation that colleges bear to schools and academies. Many of the graduates of this college have received appointments as teachers, while others are editors, authors, and writers, or are found in the various government offices, in the exercise of duties which they are quite capable of performing in an entirely satisfactory manner. In our late Centennial Exhibition there were some admirable pictures executed by deaf-mutes, as well as other products of their pencils and pens. They are also capable handicraftsmen, and are to be found in our shops and factories, as well as in the Industrial Homes founded in this city for their special benefit.

Bell's method or system of visible speech gives the teacher and also the pupil, by means of drawings, etc., a knowledge of the concealed parts of the mouth and throat, which are used in articulation, as also of the movements of the various parts, so that the pupil is thus better able to gain conscious control over them. This method of writing any sounds that the pupils may utter, serves to interest them in the practice of the elements and combinations, thus giving them great power over their organs of speech, and obviating the necessity of informing them that a sound is wrong if it is not the one which the teacher wishes to obtain. It is the practice of those who teach this system to write all sounds in the visible speech-symbols, and especially those that are essential in English speech. The symbolizing of odd sounds also leads the pupil to think and study about the parts of the mouth that produce them.

On the Method of Teaching the Deaf-Mute at Home.—I shall now discuss the following questions: (1) What is the best method of classifying deaf children, and is it advisable to place them in ordinary or in special schools? (2) How many deaf-mutes are capable of receiving articulation, lip reading, or Bell's method of instruction; and (3) Should the attempt be made to instruct all deaf-mutes by articulation, or by the sign language only?

If a child can hear sufficiently well to understand the teacher when near him, the ordinary school is, for him, decidedly better than a special school. Children sometimes become deaf after having learned to talk and read; such children may profitably attend an ordinary school, provided that the parents or teacher take time to explain the lessons; but if this be not done, the child will often recite in a parrot like manner, without understanding what he has learned, and will go over a great deal of ground with very little profit. This has been the experience of teachers of deaf-mutes, even when the pupil has learned to read quite well by observing the lips of the speaker. Congenital deaf-mutes, attending an ordinary school, may learn to write, or rather to copy, and may perhaps get some idea of numbers, but the teachers of such schools do not know how to reach their pupils' minds, even if they have the time to teach them. As a rule, such children might as well be at play, except that school occupies their time and their thoughts. Another advantage, however, which is gained for the deaf-mute children, is in their mingling as much as possible with those who hear.

If a child cannot profit by the instruction given in an ordinary school, let him if possible have a private teacher, but not necessarily in his own house, as he is not always subject to the best government there. If he needs stimulating, it may be well to place him in a class with four or five others of a suitable degree of advancement, and if this cannot be done, he may be placed in a school or institution where the instruction is especially adapted to the deaf.

If children are too deaf to profit by the common school, and yet have sufficient hearing to have acquired speech through the ear, instructors of the deaf are nearly or quite unanimous in the opinion that they should be taught by articulation and lip-reading. The experience of the teachers would lead them to say, "Let the attempt be made, if possible, to teach *every* deaf child in this way." According to Miss Rogers, Principal of the Clarke Institution for Deaf-Mutes at Northampton, Mass.: Of 116 pupils in the "Clarke Institution for Deaf-Mutes," only three have been dismissed as incapable of learning articulation and lip-reading, and one because she required more individual instruction than could be given her. The latter, however, has since been taught, so that speech and lip reading are her means of communication in her own home. Some of the remaining number of pupils (congenital mutes) speak imperfectly, but in every instance well enough to be understood in their own homes, while some of the indifferent speakers are fairly successful in lip-reading, an acquisition as valuable as that of speaking. Many congenital mutes speak so as to be understood by strangers, and will probably be able to make speech and lip-reading a successful means of communication throughout the world.¹ Of the 116 pupils at the

¹ The success of the pupils after leaving school is of great interest; extracts from a few Memorial Society letters are here given by Miss Rogers, Sept. 1, 1880.

Reports from Graduates and other Pupils—"Of the graduates of the High Class of 1875, the Institution still retains the valuable services of one as special teacher of drawing. She also teaches a primary class. Her communication with the pupils is the same as that of any other teacher. Another has been learning dress-making. She became deaf at three years and two months. Her friends think her speech improves. Of her lip-reading, she says: 'I do not remember but one whom I could not understand, and it was an old lady—she would scream so close to my ears. And at another time while walking home in the streets of Boston an old lady stopped me and inquired for a certain street. I asked to know *what* street, and all at once she put a bundle over her mouth and spoke. Of course I could not know, so I said 'I do not know.'"

"Of the graduates of the High Class of 1877, a congenital mute writes: 'I

above-named institution, one-third are semi-mutes or semi-deaf, although some of those so classed have not had hearing enough

have no difficulty in understanding my acquaintances readily, and also my employer.' 'What a blessing your school has been to the few it has sent out, and is to be, I hope, to the hundreds yet to come.' In speaking of the two who graduated with him, he says: 'I think I never met them in society without being surprised to see how readily they read lips and were understood, nor have I ever seen either of them be obliged to resort to writing. I am still in the wood-engraving business, close on my third year's apprenticeship. I like it as well as ever.' He has engraved many of the pictures in the late numbers of 'The Nursery.' The other graduate of this class has been in the Normal Art School in Boston. There is no loss attending her speech and lip-reading. The latter is noticeably good.

"Of the graduates from the Grammar Course in 1878, a congenital mute writes: 'In regard to my speech I am somewhat doubtful, but a great many friends of mine think I have improved very much in almost everything since I left school.' One who became deaf at one year of age has been in a cabinet-shop and box-factory, but is now learning engraving in a watch-factory, which he hopes may furnish him with permanent employment. He says his speech is better than when he left school, and that people have very little trouble in understanding him. Another, who became deaf at four years, but lost her speech, says: 'My mother thinks I talk very nicely, and my lip-reading is very good. Everybody can understand all I say.' She is a dress-maker. The last graduate of this class to be mentioned is a semi-mute, working in a silk-factory. She writes: 'Most people think my speech is better than a year ago, others think it is about the same. I am sure I have gained in lip-reading since last year.'

"A pupil who left some five years since (a semi-mute), writes: 'My speech and lip-reading were never better than now. The past winter I learned the dress-making trade, and am now doing well at that.' Another, who left before graduating, writes: 'My friends think I have greatly improved in speech and lip-reading. I think myself that I have improved in lip-reading, because very often, when on the laundry wagon, I meet a great many strangers who stop me and inquire about the work.' He is employed in his father's laundry.

"One young man has been employed as foreman in a printing-office. Three others, of whose speech and lip-reading no record has been received this year, have worked respectively at drawing stone, in a job printing-office, and a machine shop. One who is a gas-fitter and locksmith, writes: 'I generally talk with boss and other city men, and they understand me very well. I talk low, and try to talk nicely with my lips.' One young woman writes that she has been employed in a shoe-factory, and that her speech and lip-reading have improved. Another, who is doing housework in a family, thinks her speech and lip-reading are about the same as when she left. Still another thinks her lip-reading is about the same as before, but her speech better. She is a semi-mute, and is a frequent contributor to 'Wide Awake,' 'Babyland,' 'Little Folks' Reader,' and sometimes to periodicals for older people. A young man, who had been at work on a farm, now writes that he has work in a cabinet-shop."

Of the 83 pupils in the Institution the cause of deaf-mutism was as follows: 17 were from cerebro-spinal meningitis, congenital 20, scarlet fever 15, brain fever 7, and measles 5. There is one from a number of causes, as eroup, spotted fever, etc. etc., and three unknown. According to this table 17 pupils lost their

to learn to talk. The following is the course of instruction, communicated to the writer by Miss Sarah Fuller, Principal of the Boston Day School for the instruction of deaf-mutes: "There are sixty-eight pupils in the school, varying in age from five to seventeen years. Sixteen of these are semi-mute pupils who are pursuing the studies taught in the primary and grammar schools of Boston. As these semi-mute pupils differ in age, in natural aptitude, and in amount of previous instruction, exact classification cannot be made. They are under the instruction of two teachers, who have in addition some of the most advanced of the congenitally deaf pupils. She thinks it best to separate the semi-mute pupils from those congenitally deaf, until the latter are able to use speech and to read the lips. The plan for the instruction of young pupils, deaf from disease, is very unlike that followed in teaching children who never have heard. The former need to be encouraged to use all the speech which they may have, and to read the same from the lips of others, while the latter must first be taught to use their vocal organs, and to associate written words with objects and actions. The congenitally deaf pupils are divided into five classes. The pupils of the youngest class are chiefly occupied with vocal exercises and with articulation and lip-reading lessons. Lessons in language are subordinated to those which tend to develop speech, and are designed to familiarize the pupils with the names of common objects and actions. The pupils of the next higher class, having acquired nearly all the elements, are combining them to form words and sentences. In this class more attention is given to the acquisition of written language. All communications from the teacher are made in writing, and the pupils are beginning to reply to simple questions. To the exercises given in this class, the next higher add lessons in numbers, and preparatory lessons in geography. Reading from a primer without the aid of visible speech symbols, is begun in this class. With the pupils of the two next higher classes, speech and lip-reading are constantly employed. The pupils use text-books, but, from their limited

hearing from cerebro-spinal meningitis; this large number was, no doubt, caused by the epidemics of this disease which have prevailed during the last few years in New England. The increase in the number of children who have lost their hearing from this cause extends to portions of Europe, for in the Province of Pomerania, where there are 8.6 deaf-mutes to every 10,000 inhabitants, 278 children lost their hearing through cerebro-spinal meningitis. (See Deaf-Mute Statistics, by Arthur Hartman, M.D., Arch. Otology, Dec. 1880, p. 314.)

knowledge of language, need constant assistance from the teacher. We think it advisable to lead them to seek ideas from the printed page as soon as possible, and so encourage them in the use of books."¹

"If the child has any voice (articulation), even if the tones are rough and disagreeable, we would advise the mother or sister to teach it the articulate (or Bell's) system. To teach this system there are three things necessary, says the woman teacher, 'patience, patience, patience.' This is also so with Bell's system. As well observed by one² who has had experience in teaching his only child, 'it cannot be too clearly borne in mind that there are three things to be taught the deaf—*articulation* (with lip-reading), *language*, and *mental development*; and the skilful, conscientious, good teacher of the German system will never allow any one of these to be in advance of the other; it is not always an easy task under any circumstances. I beseech anxious parents not to make it impossible by their impatience; in the end they will be fully rewarded.' 'To be well grounded' is half the battle in all education, but more than half with the deaf; the difficulty with them is to get out of bad or slovenly habits of speaking, writing, or thought, being tenfold greater than with hearing persons. Oh, if parents would be anxious for good, not much teaching! There need be no limit to the power of the deaf when once well grounded, educating themselves after they leave school, provided they have the time and desire to do so. But if they are turned out with uneven teaching—and either their language exceeds their speech, in which case they will never be able to use that language, vocally, with comfort; or their knowledge exceeds their power of expressing it—they will be disheartened, and seldom, if ever, improve in after years; in running the race of life, one leg being shorter than the other, they will never try to win.

"And here I would entreat parents, relations, masters, teachers, and all, to be very gentle, firm, and even in their behavior to the deaf and dumb; not very kind at one time, cold at another, and angry at a third. The deaf cannot pick up, and therefore cannot realize, the hundred and one little things which go towards causing difference of manner in ordinary people as hearing per-

¹ Peet's Language Lessons and Reimer and Wilke's picture cards, which can be ordered from any bookseller.

² B. St. J. Ackers's Lecture, "Deaf, not Dumb."

sons can, and so are very sensitive and extremely suspicious if they think they have been wronged or deceived. On the other hand, if always evenly treated, they do not know what suspicion and doubt mean."

Noble, indeed, are those who take up the education of the deaf and carry it out conscientiously, lovingly, sweetly. There is great want of such teachers. The tones of the voice, which are imperfect, will go on and improve, and although it may be somewhat rough, yet will be able to make themselves perfectly understood, and give the pupil great advantages in entering an institution for a higher grade of education.

Young deaf-mute children should cultivate the sense of *touch* and *sight*, and should the child be semi-deaf, this should be much assisted by some careful attention to the condition of the ear by removing excess of cerumen, enlarging the external meatus, and even allowing the use of a small elastic, metal, or paper funnel to assist the collection of sounds when listening to a lecture, sermon, or concert.

Having made a certain progress we advance one step higher in our Instruction at Home, and endeavor to make the child understand the use of his tongue, lips, mouth shut and open sound, by placing the hand on his throat when speaking, effect of closing and shutting the nose.

Professor Graham Bell has given us the result of his investigations regarding the relative frequency of the elementary sounds used most in English; they are the short sound of *i* in words as *it*, after which come the sounds of *t*, *n*, *s*, *a* (as in *cat*), *d*, *ir* (as in *sir*), *e* (in *men*), *l*, etc. It is therefore thought best that the *words* which are oftenest used should be practised continually by the deaf child. He recommends articulating, rapidly, combinations containing *and*, *but*, *the*, with *a*, *an*, *at*, etc. He had found that senseless exercises also gave great pleasure to deaf children when the syllables were arranged rhythmically.

He would therefore recommend teachers of very young deaf children to study such a book as "Mother Goose," and to set their articulation exercises to the rhythm of the most favorite rhymes.

It is of great importance to the deaf to educate the *hand* and the *eye*. A very large proportion of "Fröebel's Kindergarten" exercises can be made useful in training at home young deaf-mute children. It is also important for physical exercise, so as to ex-

pand the chest, develop the muscles, assisting very much in getting rid of the awkwardness of the deaf-mute. The child should be taught to stand and sit properly, to gesticulate with grace and ease. The most important matter is for parents to fully appreciate the great value of the voice to the deaf child; for if once lost and not cultivated, the chances are that it is gone forever. But if persistent efforts are made by parents to make the child use the vocal organs, even at the age of three, four, or five, the chances are that it may recover part that was only apparently lost.

The following is an explanation of the articulate method as I have seen it practised with success and adapted to teaching the deaf-mute the English language at home, and lip-reading by the sense of sight. The foundation of the system rests upon the fact that articulation is simply a *mechanical* process, the result of certain well-defined positions and movements of the vocal organs, together with a more or less forcible expulsion of air from the lungs. Of the former, the sense of vision renders the deaf-mute cognizant; of the latter, his sense of feeling. All mute children are imitative—the mute child is particularly so—and it is upon the possession of this faculty, *imitation*, that our success in teaching depends. We proceed, then, at the onset, by making simple gestures with the arms, the easier gymnastics in short; then we walk, look in various directions, sit, stand, etc.

Having thus engaged the attention, place the child directly in front of you, press your upper teeth in a marked manner upon the lower lip, hold a bit of paper in your hand and blow. He sees the paper fly away, is amused, imitates the process, and has given his first letter, *f*. Again, swell your lips out with air, open them quickly, the paper flutters away; this is *p*. Should it be too forcible or not sufficiently so in forming this letter, then imitate a person smoking a pipe; the *puff, puff*, conveys the idea of *p*.

T. Place the tongue between the teeth, force the air out so that it will come in one volume, which is best felt on the back of the pupil's hand, and *t* is produced.

H is simply the expiration of breath with slightly increased force, the mouth opened naturally.

M. With closed lips the force of the letter *m* is felt by the pupil, who must apply his finger to the side of his nose; the vibration indicates the rapid expulsion of air from the lungs.

N. In the same manner the mute learns the nasal *n*, but is shown the mouth opened slightly, and the tongue pressing against the back of the upper teeth. The six consonants are the ones perhaps most easily learned.

B is formed like *p*, but is accompanied with sound; the throat is both seen and felt to dilate, and the expulsion of breath is also less forcible, the puff is gentler.

D resembles *t*, although it is better in the beginning to teach the pupil to place the point of the tongue back of the upper teeth; the vocalization is made apparent as in the case of *b*, also the less decided emission of breath.

V is simply a vocalized *f*, and, as in the case of *z* and the sub-vocal *th*, the vibration is most sensibly perceived by pressing the palm of the pupil's hand upon the crown of your head.

O. The vowel *o* is attended with no difficulty. Place the child's hand firmly on your breast that he may feel the vibration, while he sees your mouth assume the shape of the letter produced.

E. Place the pupil's fist under the angle of the jaw; the peculiar and forcible vibration there felt he readily produces.

A. Press the palm of the pupil's hand against the chest, and show him your tongue firmly set against the lower teeth, and somewhat arched; with this position the letter *a* as in *fate* is produced.

I. To form *i* open the mouth very wide, and, as you produce sound, close it quickly.

U is made like *o*, except that the lips are nearly closed.

As soon as the pupil has learned the sounds of the vowels, require him to join a consonant with each in succession, making easy syllables, as *fa, fe, fi, fo, fu*, and reversing the letters, *af, ef*, etc. Next teach him simple words, the names of objects which he can see, or pictures of them which can be shown him, as *map, mat, cap, cat, dog, horse, cow, top*, etc. The next step is to embody these in the form of a sentence, as "What is that?" "That is a cat." "What are those?" "Those are maps." The point cannot be too strongly insisted upon that the child should write, as well as speak, everything he learns. This constant practice strengthens the memory and insures steady and permanent progress.

Directions for Teaching the Deaf-mute at Home the Language of Signs.—It is stated as a positive fact that ninety-nine per cent. of deaf-mutes have the organs of speech almost normal, but there

are a few that have not, and therefore they have to depend on sight and touch, and occupy a lower rank in the scale of intelligence, and they must learn by pantomime, and for good, kiss the hand, the system of signs. Their intercourse must be limited to those who comprehend the signs, and communicate by spelling the signs on the fingers, using the alphabet sign. A person can take an object, as a hat, a dog, a cat, or any simple word of two or three letters, and pick out the letters from this or the two-handed alphabet, in which the five fingers represent the vowels, and the other signs resembling the structure of the other letters. Let the child be taught to imitate until he can make the letters of the word in order on a slate without assistance; at the same time show the object. Do this very often until the child has learned to spell the word when the object is presented to him.

Hints to the Physician.—If the child's tongue is too short the frenum may be cut and the parts stretched by pressing the cut surface. If the dorsum of the tongue is too thick or enlarged, a few incisions by the physician or surgeon will assist the free use of it, practising the protrusion of it so as to touch the lip back of the teeth; bending it on itself will favor articulation. If the child closes the teeth together tight, a plug may be placed between the teeth to prevent them coming together when too close. See that the nose is free, no broken bone, cartilage, or hole between the vomer producing nasal or obstructed sound.

My object in writing this part of my subject has been: (1) To excite a greater degree of interest in physicians, for the deaf-mute, with an endeavor on their part to prevent deafness, and so diminish the number of deaf-mutes; (2) To induce a more conscientious study and treatment, by physicians, of the ears of their patients, when the latter are attacked by scarlet or typhoid fever, cerebro-spinal meningitis, or obstruction of the Eustachian tubes as the result of measles, diphtheria, tonsillitis, or syphilis; (3) To lead physicians to give the systems of instruction pursued in our various institutions for the deaf and dumb, a certain amount of study, so as to be able to recommend intelligently to patients, their relatives or friends, the best method for each individual case; and (4) To induce physicians to recommend that there should be appointed by the Governor of each State, a commissioner, to collect, examine, and classify the deaf and dumb, so that all who are found to possess any degree of hearing, or any remnant of speech, may be taught articulation by the German

method, or that of Bell, and that those who are unable to profit by this system, may be taught the language of signs, natural or acquired.

To aid in their arduous work, I have recommended to some of our teachers of deaf-mutes, that their pupils should use mechanical appliances for improving the hearing power. By speaking or singing different vowels into one of these aids to hearing (tubes or trumpets), we can determine how much hearing the pupil possesses, and, if he be able to distinguish one vowel from another, a continued use of this mechanical aid may ultimately enable him to utilize audition as an auxiliary to vision. I have known very deaf persons, by the aid of this means alone, to have had their hearing so much improved that they could distinguish all ordinary sounds, and by some effort enter into conversation. Another important mechanical aid to persons who are deaf from diseases in which the membrana-tympani is lost, in part or in whole, but in which the inner small bone (the stapes) still remains, or in whose ears the bones have become stiff or ankylosed, is the pellet of cotton, moistened and applied near to the bones, or against the stapes, so as to bring the parts in closer contact with external vibrations, and thus cause the sounds to be transmitted to the auditory nerve.

Some writers have endeavored to prove that the brain molecules of the deaf and dumb differ from those of persons who hear; but, as I have already stated, the brain is rarely affected in those that are deaf, while on the other hand, in many instances of extensive disease of the brain, not involving the auditory nerve, deafness has not resulted. Occasionally the spine is diseased, or the nerves which, coming from that great centre, give power to the tongue and larynx, thus rendering the deaf-mute unable to articulate, no matter how much instruction he may receive. Section of the spinal accessory, or of the inferior laryngeal nerve, entirely destroys the voice, so that these may be termed the true vocal nerves. If, therefore, the centre of phonation is situated in the spinal cord, it is plain that it cannot be found in the brain; anencephalous children have been known to scream under the influence of external excitation or internal pain. The centre of the memory for words appears to reside in the brain, and attempts have been made to fix its seat in the anterior lobes, but the observations made on this subject are as yet contradictory. Each centre is independent of the other, for a cry

may be easily uttered when articulation is very difficult. *Amnesia*, or the loss of memory for words, therefore, must be distinguished from *aphasia*, or the loss of power to pronounce them; the patient suffering from aphasia can still write his thoughts, while in amnesia he can only express himself by drawing a representation of the object to which he wishes to refer.

CHAPTER VIII.

A COMPARISON BETWEEN THE AUDIPHONE, DENTAPHONE, ETC., AND THE VARIOUS FORMS OF EAR-TRUMPETS FOR THE DEAF.

SOUND is the motion or tremor produced in the molecules of the extreme filaments of the auditory nerve, or nerve of hearing, vibrating in unison with the sonorous or sounding body. The motions of the sounding body are transmitted in pulses or waves through the air, or whatever other medium it may be, into our ears,—first into the auricle or shell; then to the membrana-tympani, through the ossicles, or small bones, to the oval window; and from thence by means of the labyrinth, semicircular canals, and cochlea, to the auditory nerve. From this nerve it is conveyed to the brain, in which it is perceived as noise, musical note, or articulate speech. Certain bodies facilitate the conduction of sounds directly to the ear; others, by the indirect route, convey it by means of the teeth to the bones of the head and the nerves situated in the petrous-portion of the temporal bone.

All are now familiar with the name of "Audiphone," as its virtues were heralded by the press as a great boon to the deaf, and numerous publications, lectures, etc., have been sent broadcast over the land. Numerous experiments have been made, both at home and abroad, to find a cheaper, and perhaps a better, substitute for this object, in metal, paper, wood, etc., than the diaphragm of hard rubber, with its fan-like shape and its silken cords to give it a certain curvature and tension depending on the sounding body, so as to collect the faintest sounds and intensify them and convey them to the teeth. Our unsuccessful experiments and trials with this agent in the case of the deaf-mute have

been already reported and published in a lecture before the class of Jefferson Medical College.¹

The principle on which all these forms of apparatus, applied to the teeth, depend is the property possessed by solid bodies of transmitting or conducting sonorous vibrations to the nerve of the ear directly through the bone, which nerve is situated in a bony cavity; and this fact, which has been known for years, is further supported by the experiments of Lucæ and Politzer, published in *Arch. f. Ohrenheilkunde* in 1864, and still more recently by Professor Politzer, of Vienna, in his "*Lehrbuch der Ohrenheilkunde*" (1872, p. 214). Any one can test for himself, and prove the fact, with the tuning-fork on the head (back or front), shutting up his ears with a plug of any kind; also by the watch held between the teeth. Politzer goes still further, and states that in certain deaf persons words are understood when spoken loudly near the head. Some individuals are stated to hear words spoken near the back of the head. Now, as the auditory nerve is situated in the petrous portion of the temporal bone, we would most naturally infer that the nearer we can get to this bone the better the patient will hear the sound of music or the human voice conveyed to the auditory nerve.

A wooden rod has been suggested and employed to convey sound to the deaf by means of the teeth and bones of the head, and certain kinds of wood are capable of producing musical notes, and are employed to make a musical instrument termed the *claque bois* of the French. The mode of vibration of a wooden rod fixed at both ends is exactly like that of a string. It vibrates as a whole, and can also divide itself into two, three, four, or more vibrating parts. One of the most interesting instances in which a rod of wood was employed for the relief of deafness was in the case of the celebrated musician, Beethoven, who placed one end on the instrument and the other end in his teeth, and in this way was able to enjoy and practise his art, by the aid of another performing his compositions for him.

Persons who are only occasionally applied to by the extremely deaf, like the ordinary family physician, are not usually aware of the large number of persons who employ, with great comfort to themselves, the various forms of hearing-trumpets. If we look around in any church-congregation, concert or lecture-hall,

¹ The College and Clinical Record, Phila., March 15, 1880, p. 43.

it will be noticed that there are from two to five individuals who use this means of listening, and indeed one or more of these may be frequently seen in the street-cars in our city. Within the last month I have taken notes of a number, all intelligent and well-educated persons, who have had the opportunity of testing both means of relief to their deafness, and in all but a few cases the hearing-trumpet, in some form, has been preferred. I will briefly report a few cases of this character:—

CASE I. I. H., aged 55 years, by occupation a merchant, doing a large business, deafness the result of a very severe attack of scarlet fever in his childhood, and has been so deaf ever since as not to be able to hear the speaking voice of any one unless in the very loudest tone. Has employed all the various aids to improve his hearing, but for ordinary conversation and business purposes prefers the conversational tube (see Fig. 16, page 51, of writer's "Clinical Manual of the Diseases of the Ear"). He has tried the audiphone and dentaphone, but states that he cannot hear, unless the voice of the speaker is so elevated that all his private matters are made known to all around; he also objects to the shape, as being too conspicuous, even in the form of a fan, for a gentleman.

CASE II. Mrs. L., aged 65, a lady of great refinement and cultivation, very active habits, and who lost her hearing after fever following childbirth, nerve deafness, yet can hear her friends if they talk into her ear in a loud tone, and one at a time. Has tried the new apparatus, but would not be seen, she says, with the thing in her mouth all the time. For church and lecture, or opera, she prefers a small pocket ear-trumpet of metal, covered with black velvet (as seen in Fig. 18, op. cit., p. 53).

CASE III. R. P., aged 58, a banker, a gentleman of great intelligence and scientific knowledge, and an amateur musician. He was much interested in the invention of the audiphone, and the inventor, Mr. Rhodes, presented him with one. He is so deaf that persons have to speak to him in a loud tone, and he uses his hand to increase the reflection of sound into his ear, but he cannot use the new apparatus with any satisfaction without having to turn it to each individual, and he states that he hears some words, but others are lost; he suggests that an improvement

might be made in it by having the curve to come round on the sides. This patient has been very deaf for many years; his meatus is very narrow, with retracted and thickened membrana-tympani. Hearing distance—right ear much diminished, so that a loud-ticking watch was only heard when pressed against the temple; left ear, only on pressing the loud-ticking watch in contact with the meatus. Can, however, inflate the middle ear through the Eustachian tubes with effort. Enjoys music, and is a good musician; is able to hear the tuning-fork on his head and teeth. The deafness is the result of fever. He is able by means of a hearing-trumpet to enjoy a concert, but would like very much to have some better aid to his defective hearing.

CASE IV. Mrs. I. S., aged 52, general health fair, very deaf in both ears, but the right ear most affected; her deafness is of some fifteen or sixteen years' duration. Has suffered for many years from intermittent fever, fourteen-day chills; she has resided for a long period in a malarious region. Has no pain; hears noises of a singing, grasshopper, and at times roaring sound. Voice has a muffled sound and indistinct. Has been under treatment, but without benefit; had to resort to a hard rubber short hearing-

Fig. 1.

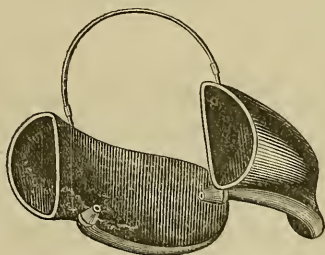


trumpet like the form figured in Fig. 1, while a portion of the large end is cut out so as to avoid reverberation, as suggested by Dr. Williams, of London. The audiphone in her case can be used about equally well, but only five or six feet, while with the trumpet double the distance, and she much prefers the trumpet for appearance and convenience. The following is a report of her condition. Meatus of both sides dry and irritable; membrana-tympani of right side opaque, sunken, and thickened. On the left, the handle of malleus is seen, but no umbo; the Eustachian tubes open, but much narrowed; inflamed and irritable throat; nose irritable; a loud-ticking watch not heard on contact on either ear; tuning-fork heard in the air, and on the teeth and forehead. Politzer's acoumeter not heard until it touches, when she feels the vibration. Inflated the middle ear with hydro-bromic ether, which improved the muffled sound, and applied

collodion to draw the membrana-tympani back to its natural position. Still under treatment.

CASE V. L. F. M., aged 18, at school, a bright girl, but very deaf unless spoken to in the loudest tones. General health stated to be good. Both ears affected; left ear most affected; duration eight years. Suffered from measles; then her eyes became diseased, almost blind. As the eyes became better she became deaf; this had been pronounced by physicians to be due to throat-deafness or involvement of Eustachian tubes. Never had any discharge from the ears; has slight singing sounds. Previous treatment, syringing the ears, inflation, etc. Meatus very dry; membrana-tympani opaque, white, and thickened; Eustachian tube on both sides open, but narrowed. Diseased nose, throat, and tonsils, which latter were very much injected. Watch (loud-ticker) not heard on contact; tuning-fork heard on forehead, occiput, and teeth; acoumeter on contact. With the audiphone and its various modifications, can hear the voice, but not what is said to her. Tested her with a pair of improved auricles (see Fig. 2). Was able to hear at any distance, and in an

Fig. 2.

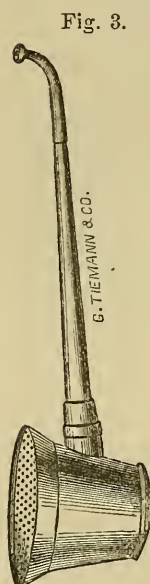


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ordinary tone. She also tested them by playing on the piano, and, instead of pounding so that she could hear herself play, she touched with taste and modulation. These improved auricles consist of two ram's-horn-shaped trumpets, connected by an adjustable spring passing over the crown of the head. They are flattened on one side in order to fit closer. The mouth-piece, being above the ear, is pointed forward; the neck passing back and downward close to the ear, tapering towards the ear-piece, which is made of soft rubber. In this case they were very *easily*

concealed, as she had an abundance of hair, which she draws over them; or they could be covered with a fancy lace cap.

CASE VI. I. C., aged 28, by occupation a machinist. Father and mother both living. His general health good, and very bright. Both ears affected, but the left the more deaf. The duration eight years; the presumed cause spotted fever, and cold taken when feeble. Slight pain in mastoid region; has a buzzing or whizzing, like letting off steam or whistle of a locomotive. Has been examined and treated both in London and New York. Meatus dry; membrana-tympani drawn inward, but not very opaque on either ear; Eustachian tubes narrow, but open. Tuning-fork heard on teeth and top of the head, and in the air; cannot hear a watch of fifteen feet when pressed against either ear. Audiphone, dentaphone, and modifications, were employed in every way, but he could only hear the sound of the voice, but no distinct articulation. With a large hearing-trumpet of the dipper form (see Fig. 3) he could hear with ease and comfort when the person spoke into the perforated part, even when sitting at table.



CASE VII. Mary I., aged 24; housekeeper; married; father and mother both living. General health not good. Both ears affected, but the right the most. Duration five years. Had specific keratitis from thirteen to sixteen years, with inherited nasal catarrh, etc. Had pain on the top of the head three or four weeks after birth of last child, which was born dead. Glands swollen and abscessed. Has had prolonged treatment of a specific character. Meatus narrowed and irritable; membrana-tympani both thickened, white and dry; Eustachian tubes slightly open. Hearing distance, fifteen feet, watch on right ear, can just feel it vibrate, but no sound. Hearing distance in left two and a half inches. Voice, very loud and close to the ear. Tuning-fork, right ear, heard in the air; left not. Nose, right side almost closed up with cicatricial tissue and disease of the turbinated bones, involving loss of uvula and tonsils.

The hearing was tested by the audiphone and dentaphone, but neither of these instruments, nor any of their various modifications, was of the slightest use in improving her hearing. With the same hearing-trumpet which was employed in previous case, No. 6, she was able to hear conversation in a loud tone.

CASE VIII. Mrs. I. W., aged 40, residence, Pennsylvania. General health fair. Both ears affected, but the left ear the most affected. Duration many years, the patient states ten years, but on careful inquiry she has been deaf a much longer period. Her husband died of phthisis pulmonalis. The presumed cause of her extreme deafness is naso-pharyngeal catarrh. Has no pain, no noises, and no discharge, except from the nostrils, which is very profuse every morning. Has been under treatment by various physicians, quacks, Indian doctors, etc. Numerous applications have been made to her meatus, which was very much narrowed. Membrana-tympani on left side opaque, but slight reflex. Right membrana-tympani very much thickened and drawn inward. Both Eustachian tubes very much narrowed, but open and dry. A loud-ticking watch is not heard in contact with either ear, but very slightly on the bones of the forehead. Tuning-fork heard on forehead, teeth, and top of the head, but not in air.

The patient has ulceration of nasal mucous membrane, turbinated bones swollen and discharging tenacious mucus. Has a sclerosed pharyngeal mucous membrane. This patient was placed under appropriate alterative, tonic, and local treatment, but not given a favorable prognosis. Her hearing was much benefited by the use of the trumpet. This patient's mother was deaf, but her deafness was caused by injury of drum-membrane.

CASE IX. Mrs. P., aged 62, deaf from catarrh of the middle ear about fifteen years. The loudest voice heard only when close to her ear. Her husband has chronic laryngitis from talking to her. Ordinary method of inflation (Politzer) was of no avail; conversational tube of slight benefit; audiphone no results. Auricles before described gave her hearing for moderately loud voice at twenty feet, and for loud whisper at two feet. Large funnel-shaped ear-trumpet not so satisfactory.

CASE X. Mrs. H. B., aged 65, deaf for many years, and can hear the voice when very close to the ear and in a very loud tone;

could hear the tuning-fork over the forehead, occiput, and temple. Meatus healthy; membrana-tympani of pearly color and not sunken. Has artificial teeth, which fit well. Her hearing was then tested by the audiphone and dentaphone, but with no improvement, nor did the hearing-trumpet improve this individual's hearing.

CASE XI. Sarah S. M., of Montgomery County, Pa., aged 29; occupation seamstress. Hearing distance, not on contact. Tinnitus (roaring). No discharge. Membrana-tympani; right, sunken; handle horizontal, good reflex. Membrana-tympani; left, sunken; handle horizontal, good reflex. Eustachian tube not closed. Throat normal. Velum irritable, and posterior space narrow antero-posteriorly. Duration four months. Hereditation good. Constitution good. Complications uterine. The audiphone was of no benefit, nor was any form of hearing-trumpet.

It has been a question of some importance among dentists to know what denture would best supply the natural teeth when lost. In using the audiphone Dr. Osmun¹ has instituted a number of experiments to test the merits of each, and he has reported the results: "A lady who had been deaf for nearly twenty years called at my office to obtain a new denture which would enable her to hear better with the audiphone. The one she was using was on silver, and was ill-fitting. Believing that accuracy of fit was the all-essential point, I naturally advised vulcanite. She, however, had been urged by several of the profession to wear gold, on account of its being a good conductor of sound. Consequently, I made her a set of each base for trial. She reports as follows: 'I can hear very well with the silver plate, better with gold, but with the vulcanite set the tones are much louder, and I can hear at a greater distance.'" Not being satisfied with a single trial, he repeated it in a case of a partial denture, with the same results. Result in two patients, both of them preferred the vulcanite denture.

We have repeated a number of experiments with the rod of wood against the musical box, and when both ears are closed, the sound is as loud with the vulcanite as with the natural teeth. There is very little conduction of sound with the lower teeth. So far as our experience in the use of the vulcanite denture goes,

¹ The Audiphone, by I. Allen Osmun, D.D.S., M.D. The Independent Practitioner, Baltimore, Md., March, 1880, p. 135.

we have found it to be very much superior in fit and finish to the metallic plates of the early times. As for the injury which this denture has done in increasing deafness, producing irritation, etc., it has not yet come under our observation in any of our patients.

The conclusions here arrived at are that, so far as the deaf-mute is interested, the invention, under its present form, is not likely to prove of much value to him in acquiring articulation. I have always advised the use of the hearing-trumpet in teaching the semi-deaf-mute, by means of which a large volume of sound can be collected, condensed, and transmitted to the nerve of hearing, so as to produce gymnastics of the hearing apparatus, and arouse it into action.

It has been stated by the agents of the inventor that in the city of Philadelphia about sixty deaf individuals have been benefited by the audiphone, and now employ this means of improving their hearing. This number, I judge, has been much reduced of late. Of those who continue to employ the instrument, some are decidedly benefited by its use, and are able to enjoy the comforts of home, even hear a baby's voice, which they never heard before. In one case a reporter, from his being able to hear with this instrument, has been advanced in his profession, showing that it certainly increases the acuteness of the hearing; and in the future it may be the means of exciting an interest in the study of the methods to improve the hearing powers of the deaf. The instrument may yet be so modified as to be found very valuable.

In receiving this means we must not ignore or despise the various equally useful hearing-trumpets which have been from the earliest times employed by the deaf, and which of late years have been so improved in form and in quality as to receive and convey sounds to the ear, increasing the acuteness in a larger proportion than either form of the audiphone or dentaphone.

The results of our experiments are as follows: in the ten cases of deafness only one was decidedly improved in the acuteness of his hearing by the audiphone, two were not benefited by either apparatus, while six were greatly improved by the various forms of the hearing-trumpet, and the one who could hear about as well with the one as with the other preferred using the hearing-trumpet.

Other impartial observers have tested the audiphone, and found that it falls far short of what its inventor claimed for it. Most

of these experiments have been expressed in general terms. Dr. Knapp¹ and the writer have gone a little more into detail, and the former has made quantitative determinations in a table of fourteen cases. His conclusions are as follows: "The audiphone is not a useless instrument; it increases, in a moderate degree, the hearing power of the majority of very deaf persons. In every case, as far as my examinations have gone, was its value exceeded, and in most cases greatly exceeded by the ear-trumpet" (as seen in Fig. 3, being a small size of the dipper-shaped instrument which was employed in Case VI.).

W. B. Dalby, F.R.C.S., M.A., the chairman of the Sub-section of Otology of the British Medical Association, at its meeting at Cambridge, Sept. 4, in summing up the conclusions on this subject, stated as follows: "That the audiphone was only useful for incurable cases of disease of the middle ear, or closure of the external canal. In both classes of cases it was absolutely necessary that the nervous structures should be unimpaired."

See, also, paper (in Archives of Otology, Dec. 1880, p. 307) "On the Use of the Dentaphone with Deaf-mutes," by Edmund Treibel, Superintendent of the Royal Asylum for the Deaf and Dumb in Berlin. The following are his conclusions: "I may safely state, therefore, that where deaf-mutes are concerned, the dentaphone (3 tested), in their present condition, at least, cannot be put to any practical use, not even as a means of advancing articulation."

I desire to state, in conclusion, that a very large number of patients who have come with the strong desire to try the audiphone, dentaphone, etc., by judicious treatment of the middle ear, the healing of a perforation, etc., or by the use of an artificial membrana-tympani, have gone away so much improved as not to require the use of any form of apparatus to aid their hearing. The improved modes of diagnosis and of treatment of diseases of the ear, founded on a more perfect knowledge of the anatomy and physiology of these important organs, have done very much to prevent the occurrence of those cases of deafness which, when treated early, are curable, but, if permitted to run on, by very long-continued chronic inflammation and ulceration will destroy the integrity of the organ itself in its most vital parts. Such unfor-

¹ Some Observations concerning the Value of the Audiphone. Dr. H. Knapp, Archives of Otology, vol. ix. p. 83, March, 1880.

tunate cases must resort to various mechanical appliances to improve their condition, by bringing a larger volume of sound to the nerve to arouse it to activity, so that the deaf not only hear sounds, but will also be enabled to distinguish articulate speech. Of such available instruments, I consider that, at present, the hearing-trumpet has the widest range of application.

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